EFFECTS OF CAPITAL STRUCTURE ON UTILITIES' COSTS OF CAPITAL AND REVENUE REQUIREMENTS

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Abstract

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Electric, gas, and telephone utilities have recently been reducing their debt ratios and generally improving their balance sheets. This trend has raised two questions: (1) How do changes in capital structure affect the cost of equity? (2) Is there an optimal capital structure, defined as one that minimizes revenue requirements over the long run, and if so, what is it? The Florida PSC asked us to study these issues.

We began our analysis with a review of the business risks faced by the utilities. That analysis indicated that, even though most utilities' positions have improved during the past two or three years, the general trend in business risk has been up, and all utilities today face more business risk than they did in the 1960s and early 1970s. Since the optimal capital structure depends heavily on business risk--the higher its business risk, the lower a company's debt ratio--the recent balance sheet improvements are highly desirable.

We also examined the major theoretical and empirical works on the relationship between capital structure and capital costs, and we did some empirical work of our own. We concluded that a one percentage point change in the debt ratio causes, on average, a change of about 12 basis points in the cost of equity. However, we also found, using a Lotus 1-2-3 computer model, that changes in the costs of debt and equity are offset by changes in the weights used to calculate the overall rate of return. As a result, the overall rate of return is not affected significantly by capital structure changes.

Our major conclusion is that capital structure decisions, within the range over which most utilities operate, have negligible effects on revenue requirements. Operating decisions, on the other hand, can and do have major effects. Therefore, capital structure decisions should be focused on insuring that financial constraints do not hinder operations.

SUMMARY AND OVERVIEW: CAPITAL STRUCTURE, COST OF CAPITAL, AND REVENUE REQUIREMENTS

Most utilities have recently been reducing their debt ratios and generally improving their balance sheets. This trend has raised two questions: (1) How do changes in capital structure affect the cost of equity? (2) Is there an optimal capital structure, defined as one that minimizes revenue requirements over the long run, and if so, what is it? The Florida PSC asked us to study these issues.

Our report consists of this 30-page Summary and Overview section plus seven technical appendices which provide details of the study. Here is an outline of the entire report:

Summary and Overview:	Capital Structure, Cost of Capital, and Revenue Requirements
Appendix A.	The Changing Business Risk Environment
Appendix B.	Capital Structure Theories
Appendix C.	Prior Empirical Studies of the Effects of Leverage on the Cost of Equity
Appendix D.	The PURC Regression Study
Appendix E.	Using Bond Rating Guidelines to Estimate the Effects of Leverage on the Cost of Capital
Appendix F.	Description of the PURC Capital Structure Model: Electric and Gas Companies
Appendix G.	Description of the PURC Capital Structure Model: Telecommunications
Appendix H.	Bibliography

Background

One of the most controversial aspects of a typical rate case is the rate of return the utility is allowed to earn on its rate base. Generally, a weighted average cost of capital (WACC) is found using this equation:[1]

$$WACC = w_d k_d + w_p k_p + w_s k_s. \quad (1)$$

Here the w's are the weights and the k's are the component costs of debt, preferred, and common equity. Embedded costs are used for debt and preferred, but a current cost rate is used for common equity. The weights can be based on the actual capital structure at a given date, or on an "imputed" capital structure if there is reason to believe that the actual capital structure is for some reason inappropriate. The choice of weights can have a significant effect on the resulting weighted average cost, and that, in turn, can have a significant effect on revenue requirements, customers' bills, and the company's earnings. Thus, capital structure can be an important rate case issue.

The optimal capital structure depends primarily on a company's business risk: The higher its business risk, the lower

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[1]For unregulated companies, the equation is written as

$$WACC = w_d k_d(1 - T) + w_p k_p + w_s k_s,$$

where T is the marginal corporate tax rate, and where current rather than embedded cost rates are used for debt and preferred as well as for common equity. Further, in most of the academic work on the cost of capital, weights are based on market values rather than book values. Those differences are truly profound, and they require major modifications when one tries to apply work done on industrial companies to utilities.

its optimal debt ratio, other things held constant. Further, the past 20 years have witnessed a sharp increase in business risk for all utilities--since 1965, business risk has trended up due to inflation, regulatory lag, increased competition, nuclear problems, and declining growth rates.[2] Further, there has been a change in regulators' attitudes toward who should bear these risks, customers or investors, and today the general feeling is that investors are being required to bear a larger share than in the past.

Because of these increases in business risk, the utilities should have begun to raise their equity ratios back in the 1960s. However, the top section of Table 1 shows that did not happen--equity ratios actually fell from 1965 to 1975, when business risk was rising most rapidly. However, after the 1975 low point, the situation improved. Earnings increased, so retained earnings increased, and market/book ratios moved up, making it more feasible to issue common stock. Even more important, construction programs slowed, so the equity buildup was not offset by an increase in debt. Currently the electric and gas companies, on average, have stronger equity ratios than in 1965, while the telephone companies are approaching their earlier levels.

The timing of these events differed significantly among companies. For example, Consolidated Edison stopped building new plants back in the early 1970s, so its equity buildup began relatively early, and by 1985 its equity ratio was close to 55

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[2]See Appendix A for a discussion of business risk.

percent versus an industry average of about 42 percent. That difference prompted the New York Commission to hold hearings on Con Ed's capital structure, and the result was a 50 percent regulatory cap on equity and an agreement by the company to institute a stock repurchase program designed to bring its actual equity ratio down closer to the cap. Similar situations have developed in other states.

Table 1
Equity Ratios in the Utility Industries

A. 1965-1983

	Equity Ratios			
	Electric	Gas	Telephone	Industrials
1965	38%	44%	66%	75%
1975	33	39	45	64
1983	39	47	55	65

B. 1981-1989

	Equity Ratios			
	Electric (East)	Gas	Telephone (Entire Industry)	Industrials
1981	38%	50%	51%	n.a.
1983	40	50	54	n.a.
1985E	42	52	56	n.a.
1986E	42	52	57	n.a.
1989E	43	52	58	n.a.

Sources: Section A: Compustat. The electric and gas data represent weighted average industry data on a book value basis. The telephone data reflect only AT&T, which represented about 80 percent of the industry prior to 1984.

Section B: Value Line. April 25, 1986; October 11, 1985; March 28, 1986. The telephone data reflect the entire industry as reported by Value Line.

The telephone companies, especially the Bell regional holding companies, have also come under study. It has been observed (1) that the telcos have higher equity ratios than the electrics and (2) that the telcos' equity buildup over the last 10 years has been especially pronounced. This has raised the question of whether some telcos have "too much" equity. Again, New York has been a leader in this regard, in part due to the interest generated by the Con Ed case. However, there are significant differences between telephone and electric companies, and one can argue that the telcos are exposed to more business risk than the non-nuclear-construction segment of the electric industry, and, consequently, that the telcos should use more equity. Indeed, Judge Green took exactly that position when he decreed that the regional holding companies should be spun off from AT&T with a minimum of 55 percent common equity. (The average electric at the time (1983) had a 40 percent common equity ratio and a total equity ratio, including preferred, of about 50 percent.) Based on evidence presented in the hearings, the New York Commission decided not to use an imputed capital structure in a recent New York Telephone rate case--rates were based on an actual capital structure that contained well over 55 percent equity.

Capital Structure and Diversification

Many utilities are diversifying, and that raises another capital structure issue. The argument can be made that utility operations are exposed to less business risk than non-utility operations, and consequently that utilities should employ more debt than industrial companies. Now consider the implications if a utility diversifies and has this situation:

	Utility Subsidiary		Unregulated Subsidiary		Consolidated	
Debt	$ 450	45%	$ 50	25%	$ 500	41.7%
Preferred	100	10	0	0	100	8.3
Common	450	45	150	75	600	50.0
	$1,000	100%	$200	100%	$1,200	100.0%

No regulatory problems should arise in this situation--the utility's own capital structure should be used for ratemaking purposes. Questions would arise, though, if the parent company issued its own debt and used the money raised to supply equity to the utility--this would raise the issue of "double leverage." The key thing is to keep the utility totally separate from the other elements of the holding company system.

Note, though, that a possible problem exists even with a separated system. Suppose the cost of equity is determined on the basis of market data using DCF methodology, as it would be in most jurisdictions. The DCF equity cost would be that of the parent--only the parent company's stock price, dividend, and growth rate can be used in a direct DCF analysis. However, the parent's DCF cost of equity reflects the combined business risk of the utility and non-utility operations, and both subsidiaries' financial risks. This makes it difficult to determine the utility's cost of equity.[3]

[3]One should in this situation attempt to find a group of nondiversified utilities with business and financial risks similar to the utility subsidiary of the holding company, and then allow the utility to earn a return equal to the average DCF cost of the comparable companies. However, it is getting harder and harder to find comparable nondiversified utilities.

Capital Structure Theories

Finance theory provides helpful insights into capital structure issues, but the theory leaves many key questions unresolved. A quotation from Professor Stewart Myers' 1983 Presidential Address to the American Finance Association summarizes the situation:

> We know very little about capital structure. We do not know how firms choose the debt, equity, or hybrid securities they issue.... There has been little if any research to test whether or not the relationships between financial leverage and investors' required returns is what theory would predict. In general, we have an inadequate understanding of corporate financing behavior, and of how that behavior affects security returns.
>
> I do not want to sound too pessimistic or discouraged. We have accumulated many helpful insights into capital structure choice.... We have thought long and hard about what these insights imply for optimal financial structure. Many of us have translated these theories, or stories, of optimal capital structure into more or less definite advice to managers. Yet our theories don't seem to explain actual financing behavior, and it seems presumptuous to advise firms on optimal capital structure when we are so far from explaining actual decisions.[4]

Myers' statement is absolutely true--finance theory can provide useful insights into the factors that determine an appropriate capital structure, but one cannot use finance theory either to specify the effect of leverage on the costs of debt or equity or to identify the optimal capital structure for a given company. Capital structure decisions must be made on the basis of informed judgment and market data, not by mathematical formulas. Still,

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[4]See Stewart C. Myers, "The Capital Structure Puzzle," Journal of Finance, July 1984, 575-592. Also, see Appendix B for a more thorough discussion of capital structure theories.

finance theory can provide insights which can help us make better judgments.

Capital structure theory has been developed along two major lines:

1. Tradeoffs between Tax Savings and the Costs of Financial Distress. The tax savings tradeoff theory is associated with Franco Modigliani and Merton Miller (MM), and it postulates that the optimal capital structure for a firm can be established by examining the tax savings that result from the use of debt versus the drawbacks of leverage associated with various aspects of financial distress.
2. Signalling, or Asymmetric Information, Theory. This theory postulates (1) that managers and investors have different information about firms and their prospects, (2) that investors generally view an equity offering as a sign that the issuing firm's prospects are not bright, and (3) that investors therefore lower the price of a firm's stock and consequently raise its cost of equity when a new stock offering is announced. From this it follows that firms should use less debt than they otherwise would during "normal" times so as to build "reserve borrowing capacity" that can be used when above average amounts of funds are needed.

Both theories have merit, and both should be taken into account.

The Relationship between Financial Leverage and the Cost of Equity

Theoretical Studies

Several theories, all of them rooted in the classic propositions set forth by Modigliani and Miller (MM) in 1958 and 1963, have been proposed to explain the effect of leverage on the cost of equity. MM themselves postulated that the cost of equity increases with the use of debt in a precise manner: The cost of equity to a firm that uses debt equals the cost of equity to an unlevered firm plus a risk premium that increases linearly with the debt-to-equity ratio. However, the MM model is based on some simplifying assumptions that do not hold in the real world, so other finance theorists, including Miller, have modified the original MM model. All the theories agree that the cost of equity increases as a firm uses more and more debt. However, the exact specification of the relationship depends on the underlying assumptions, and no one knows which set of assumptions is most correct, or even if any of the assumption sets is good enough for practical applications.

Figure 1 and its accompanying notes show the relationship between financial leverage and the cost of equity under perhaps the three best known theories. We do not present this material to indicate what we believe the true relationship to be--rather, we use it to demonstrate the huge differences between three popular theories.

Several others have relaxed MM's assumptions, which is good, but as a result their models do not provide specific, mathematically precise formulas into which real-world data can be inserted to produce "answers." As a rule, though, the alternative tradeoff theories suggest results which lie between the extremes shown in Figure 1.

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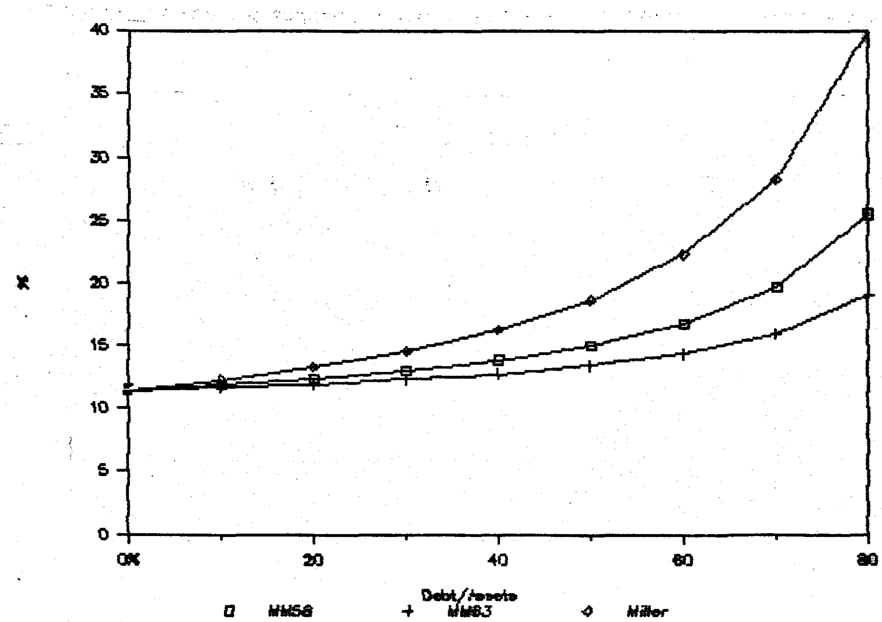
Figure 1
Theoretical Relationships between
Financial Leverage and the Cost of Equity



D/A	D/E	Cost of Equity MM (1958) (1)	MM (1963) (2)	Miller (3)
0%	0.00	11.50%	11.50%	11.50%
10	0.11	11.89	11.71	12.29
20	0.25	12.38	11.97	13.30
30	0.43	13.01	12.31	14.55
40	0.67	13.85	12.77	16.31
50	1.00	15.00	13.39	18.68
60	1.50	16.75	14.34	22.27
70	2.33	19.66	15.90	28.23
80	4.00	25.50	19.06	40.22

Notes:

a. For these calculations we assume that the firm uses only debt and common equity.

(Figure continued)

b. Capital structure ratios must be measured in market value terms to apply the MM and Miller equations. For a public utility operating under "perfect," lag-free regulation, market values must be equal to book values. For unregulated firms, the benefits of leverage (tax savings) accrue to stockholders and result in higher stock prices. For utilities, tax benefits accrue to customers, so market values remain equal to book values.

c. All calculations of k_s assume that for an unlevered firm k_s = 11.5%, k_d = 8%, and T = 46%.

d. Both MM and Miller assume that k_d for the leveraged firm is equal to k_d of the unlevered firm; that is, k_d = 8% regardless of the level of debt financing.

e. In their 1958 work, MM assumed zero taxes, and they developed the following equation, which we used to calculate the Column 1 values:

$$k_s = k_u + (k_u - k_d)(D/E)$$

$$= 11.5\% + (11.5\% - 8\%)(D/E)$$
$$= 11.5\% + 3.50(D/E).$$

f. MM in 1963 brought corporate taxes into the analysis, but no personal taxes, and they then developed this equation which we used to calculate the Column 2 values:

$$k_s = k_u + (k_u - k_d)(1 - T)(D/E)$$

$$= 11.5\% + (11.5\% - 8\%)(0.54)(D/E)$$
$$= 11.5\% + 1.89(D/E).$$

g. Miller in his 1977 work assumed corporate and personal taxes; the Column 3 values were calculated using this equation:

$$k_s = k_u + [k_u - (1 - T)k_d](D/E)$$

$$= 11.5\% + [11.5\% - (1 - 0.46)8\%](D/E)$$
$$= 11.5\% + 7.18(D/E).$$

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<u>Empirical Studies</u>

When it became clear that theory could not be used to establish the relationship between leverage and the cost of equity, researchers turned to empirical studies. Table 2 summarizes several key studies, along with the predictions of the three main versions of the tradeoff theory. The empirical results vary considerably, and while they all show that equity costs increase with leverage, they are generally smaller than suggested by the theories.

Table 2
Results of Prior Empirical Studies
Compared to Theoretical Results

Theoretical Studies	Increase in Equity Cost when Debt-to-Total-Assets Ratio Increases from 40 to 50 Percent
MM (1958)	115 basis points
MM (1963)	62
Miller (1977)	237
Average	138
Empirical Studies	
Brigham & Gordon (1968)	34
Gordon (1974)	45
Robichek et al. (1973)	75
Mehta et al. (1980)	109
Gapenski (1986)	72
Average	67
Risk Premium	
Brigham, Vinson & Shome (1983)	120

Note: The studies reported here are discussed more fully in Appendices C and D. The theoretical models (MM and Miller) were fitted using 1986 data, and the empirical studies were all adjusted to reflect changes in interest rates between the time the studies were conducted and 1986.

As a part of the PURC project, Louis Gapenski conducted a new, updated study of the empirical relationship between capital costs and financial leverage; his results are described in detail in Appendix D. Basically, Gapenski found that an increase in the debt-to-total-assets ratio from 40 to 50 percent resulted in an increase in the cost of equity of about 72 basis points when leverage is measured in terms of expected book values. As Table 2 shows, Gapenski's findings are reasonably consistent with the earlier empirical work.

However, as we explain in Appendices D and E, all of the empirical studies, Gapenski's included, understate the true relationship because of errors in measuring the independent (leverage) variable. Thus, the effect of a change in leverage is greater than the empirical studies indicate. Once the measurement error bias is corrected, a change in the debt ratio from 40 to 50 percent range leads to a 120 basis point change in the cost of equity.

<u>The Bond Rating (Risk Premium) Method</u>

The effects of changes in leverage on the cost of equity can also be estimated by the risk premium approach as described in Appendix E. The approach combines the bond rating guidelines published by Standard & Poor's, interest rates on bonds with different ratings, and a knowledge of the relationship between the costs of debt and equity to a company. For example, to be rated AA, the guidelines indicate that an electric utility should have a debt-to-capital ratio in the range of 40 to 45 percent. The rating guidelines, along with bond yield data, can be used to estimate the relationship between leverage and debt costs, and, with less precision, the effect of leverage on equity costs.

For the electric utilities, each percentage point change in the debt-to-capital ratio results in a 7.8 basis point change in interest rates within the 42.5 to 48 percent debt leverage range, and a 10 basis point increase for debt ratios within the 48 to 54 percent range. The data did not permit analysis outside the 42.5 to 54 percent range, so we cannot state exactly what would happen to interest rates if debt were below 42.5 or above 54 percent. However, assuming that the 7.8 basis point adjustment also applies in the 42.5 to 40 percent range, a change in the debt ratio from 40 to 50 percent would cause the cost of debt to change by 82 basis points:

$$\begin{aligned}\text{Change in cost of debt} &= 2.5(7.8) + 5.5(7.8) + 2(10)\\ &= 82.4 \text{ basis points.}\end{aligned}$$

This methodology can be extended to estimate the effects of leverage on the cost of equity. We know that the same fundamental factors that affect the riskiness of a company's bonds also affect the riskiness of its stock. Therefore, if something occurs to cause the riskiness and consequently the cost of the firm's debt to increase, then the cost of its equity would also rise. Most of the work in finance theory, and also common sense, suggests that the effect of an increase in leverage should be greater on the cost of equity than on the cost of debt. The reason, basically, has to do with the fact that bond interest is a fixed claim against income whereas stockholders' returns are a residual. Therefore, as long as operating income exceeds interest charges, changes in operating income have no effect on bondholders' returns, but any change whatever affects common stockholders. For this reason, at very low debt ratios, adding more debt has little effect on a bond's risk and required return, but the additional debt would affect stockholders.

Our studies indicate that if a 10 percentage point increase in the debt ratio, from 40 to 50 percent, would increase the cost of debt by 82 basis points, then the effect on the cost of equity would be 30 to 40 basis points greater.

The PURC Capital Structure Model

From a regulatory viewpoint, the key capital structure issue is its long-run effect on revenue requirements. To assess this effect, we developed a Lotus 1-2-3 model which tests the sensitivity of revenue requirements and other output variables to capital structure changes.

Table 3 gives the key results of the model runs for the electrics. Similar runs were made with a version of the model adapted to telephone companies. Data were generated for every year from 1986 to 2001, but to avoid unnecessary detail, only selected years are shown. Section I focuses on the weighted average cost of capital, Section II on revenue requirements, Section III on residential bills per 1,000 KWH, and Section IV on interest coverage ratios.[5]

By comparing Lines 1 and 4 in Sections I, II, and III, we can see the results in the most likely case versus the no-capital-structure-change case. The most striking feature is that

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[5]The weighted average cost of capital given in Table 3 is different from the one discussed in rate cases. The one we show "grosses up" the return on preferred and common to a before-tax basis. If the before-tax WACC is at a minimum, then the sum of interest, preferred dividends, the return to common, and income taxes will also be minimized.

Table 3
Key Results of the Energy Model Runs

I. WACC	1986	1987	1990	1995	2000	2001
Most Likely Case	15.91%	16.04%	16.45%	16.53%	16.49%	16.48%
Low Sensitivity Case	16.11%	16.24%	16.66%	16.75%	16.71%	16.70%
High Sensitivity Case	15.72%	15.84%	16.24%	16.32%	16.27%	16.26%
Base Case: No Cap. Struc. Chge	16.30%	16.30%	16.30%	16.30%	16.30%	16.30%

II. Revenue Requirements	1986	1987	1990	1995	2000	2001
Most Likely Case	$4,310	$4,628	$5,731	$8,080	$11,376	$12,182
Low Sensitivity Case	$4,326	$4,645	$5,753	$8,112	$11,421	$12,230
High Sensitivity Case	$4,295	$4,611	$5,709	$8,048	$11,331	$12,134
Base Case: No Cap. Struc. Chge	$4,335	$4,643	$5,704	$8,038	$11,326	$12,130

III. Average Bill	1986	1987	1990	1995	2000	2001
Most Likely Case	$93.19	$98.11	$114.48	$146.18	$186.41	$195.70
Low Sensitivity Case	$93.53	$98.47	$114.92	$146.75	$187.15	$196.48
High Sensitivity Case	$92.86	$97.75	$114.04	$145.60	$185.67	$194.93
Base Case: No Cap. Struc. Chge	$93.74	$98.43	$113.94	$145.42	$185.60	$194.87

IV. Coverage Ratio	1986	1987	1990	1995	2000	2001
Most Likely Case	3.79	3.92	4.33	4.50	4.53	4.53
Low Sensitivity Case	3.84	3.97	4.39	4.56	4.59	4.59
High Sensitivity Case	3.75	3.87	4.28	4.44	4.47	4.48
Base Case: No Cap. Struc. Chge	3.86	3.86	3.86	3.86	3.86	3.86

capital structure changes have a very small impact on any of these key variables. In 2001, 16 years after the decision to change the capital structure, and 11 years after the change was fully implemented, revenue requirements differ by only $52 million on a base of over $12 billion (4/10th of 1%), and the average customer's bill differs by only 83 cents on a base of $195 (again, 4/10th of 1%). Differences are even smaller in the near term. In view of the uncertainty over the values to assign to the inputs, these differences are not significant.

<u>The overriding conclusion to be drawn from our analysis is this: Capital structure changes have little impact on a utility's revenue requirements or its customers' bills. Capital structure does affect the cost rates of both debt and equity, but changes in those variables are offset by changes in the weights of each capital structure component.</u>

The model also shows that the impact of capital structure changes is dwarfed by the impact of operating cost changes. The output provided with this report does not show it, but when we sat in front of the monitor and changed our assumptions about fixed and variable costs, tax rates, inflation, growth in demand, and the like, we observed huge changes in revenue requirements and customers' bills. The effects of capital structure changes simply do not compare in magnitude with the effects of possible changes in operating conditions. <u>That, in turn, leads to the conclusion that the primary focus of capital structure decisions should be on insuring that financial constraints do not hinder efficient operations, not on the effects of capital structure per se on revenue requirements.</u>

Shock Cases: What Happens if Projections Are Not Met?

In our computer runs, we projected unit sales, fixed costs, variable costs, inflation, and so on, and then the model calculated the revenues needed to achieve a target rate of return. Our results show that, under the expected set of conditions, capital structure has little effect on the key output variables. Suppose, though, that things do not work out as projected. Here are some business risks that could throw the projections off:

1. Fixed operating costs could increase due to an increase in depreciation. If a company builds a plant which ends up costing more than was originally projected, then both fixed operating costs (which include depreciation) and financing costs will rise. This has happened to many electric utilities, especially those with nuclear plants.

2. Demand could fall below the projected level. For example, an electric company could forecast a demand for X KWH of power in 1993 and build the capacity to meet that load, but then find, in 1993, that actual demand is far below the original forecast. Conservation, low industrial production, losses to cogeneration, by-pass for telephone companies, or fuel oil price declines for gas companies could produce an excess capacity situation.

3. Variable costs could rise sharply; the best recent example of this was the electric industry's experience when oil prices rose during the 1970s.

4. Inflation might return to double-digit levels. We projected inflation at 5 percent, which is in line with many current forecasts, but the rate of inflation could move back up to 10 percent or more. If that happened, the cost of capital would rise, as would variable operating costs and, with a lag, fixed operating costs.

5. Plant retrofits might be required to protect the environment. Acid rain has long been a concern, and now studies are coming out which suggest that a serious "greenhouse" effect may be occurring.

6. All utilities with nuclear plants face the possibility of an accident or a prolonged (or even permanent) unscheduled shut-down. Such an event would require expensive

replacement power, and it might also require the construction of new generating plants.

These are all examples of business risks, and they are the kinds of events that a strong capital structure is designed to help a firm overcome. Indeed, the main reason for having a strong equity ratio is to enable a company to recover from adverse business conditions with minimum damage.

When analyzing the capital structures of industrial companies, the standard procedure is to run different business risk scenarios to see how different capital structures affect a company's ability to deal with shocks. Table 4 gives a simplified example of how one might examine the effects of demand shifts on earnings per share and on the coverage ratio.[6] The main points to note are these: (1) If conditions are bad, net income, EPS, and the interest coverage ratio will all drop, and vice versa if conditions are good. (2) The effects of shocks are more pronounced the greater the company's use of financial leverage. (3) Under bad conditions, the highly leveraged firm will have great difficulty raising capital to correct its problems, because it will not be covering its interest and it will have negative earnings. However, with less leverage, the firm will be able to raise capital even under bad operating conditions.

Would these same results hold for a regulated utility? The answer is not clear. Notice that the top section of Table 4,

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[6]For an in-depth analysis of a capital structure model for industrial firms, see P.D. Cretien, S.E. Ball, and E.F. Brigham, Financial Management with Lotus 1-2-3, Chapter 12.

Table 4
Analysis of Capital Structure Effects
under Different Economic Conditions

		Bad Conditions	Normal Conditions	Good Conditions
Units sold		117,000	150,000	183,000
Price per unit	0.074	$0.074	$0.074	$0.074
Revenues		$8,658	$11,100	$13,542
Fixed operating costs		$4,500	$4,500	$4,500
Variable operating costs		3,510	4,500	5,490
Total operating costs		$8,010	$9,000	$9,990
Operating income		$648	$2,100	$3,552
LEVERAGE: 40% DEBT, 60% COMMON				
Less: Interest (10%)		400	400	400
Taxable income		$248	$1,700	$3,152
Less: Taxes (46%)		114.08	782	1449.92
Net income		$134	$918	$1,702
Earnings per share (6,000 sh)		$0.22	$1.53	$2.84
Interest coverage		1.62 X	5.25 X	8.88 X
LEVERAGE: 60% DEBT, 40% COMMON				
Less: Interest (12%)		720	720	720
Taxable income		($72)	$1,380	$2,832
Less: Taxes (46%)		(33)	635	1,303
Net income		($39)	$745	$1,529
Earnings per share (4,000 sh)		($0.10)	$1.86	$3.82
Interest coverage		0.90 X	2.92 X	4.93 X

where operating income is developed, is not affected by the firm's capital structure.[7] If an industrial company's sales fall, it cannot normally raise its prices and thus force its remaining customers to cover its fixed costs. However, a utility company can, in theory, do just that. Indeed, under "perfect" regulation, if demand falls below the projected level, sales prices would be adjusted so as to keep the earned rate of return equal to the cost of equity.

Obviously, "perfect" regulation is a myth. If a utility's demand fell below expectations, an attempt to raise prices might simply reduce demand further--this has happened to the gas companies, and it could happen to the utilities and telcos. Further, even if demand were inelastic enough to permit the price increases necessary to enable the company to earn its cost of capital, excess capacity might call forth the question of prudence: Was it prudent for the company to build so much capacity in the first place?

With all this in mind, we attempted to analyze the effects of various types of shocks on utilities with different capital structures. However, problems with such an exercise became immediately apparent. It is easy enough to see that shocks would have adverse effects on operating income, unless offset by rate increases, and on rates if offsets were imposed, but we have no way of knowing how shocks would be handled in the regulatory

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[7]This assumption is commonly made, and it is generally true provided the unregulated firm's capital structure remains within reasonable bounds. See E. F. Brigham and L. C. Gapenski, Intermediate Financial Management, Chapter 6, for a full discussion.

process. So, whereas we could justify and defend all the assumptions used in the non-shock model runs, we have no way of supporting shock case assumptions. Therefore, no shock case runs are presented in the report.

Capital Structure and Construction Cycles

Theory suggests that the optimal capital structure should be set so as to obtain the maximum tax benefits of debt during "normal" times yet still maintain unused borrowing capacity to draw upon during times of stress. There is an old saying, "If you don't need money, the banks would love to lend to you." The same thing holds in all capital markets--if a company is strong, it can raise funds at a reasonable cost from many different sources, but if it is weak, it cannot get money on reasonable terms without collateral. Therefore, in times of stress companies need access to the first mortgage bond market.

In the minds of most investors, the greatest risks for an electric utility are associated with construction. If a company has all of its generating plants in its rate base and is earning cash returns on them, then it will probably be regarded as a strong company. On the other hand, if it is in the midst of a major construction program, it will be perceived as facing risks. Planning and building a base load generating station generally takes from 8 to 12 years, and much can happen during that time--costs can escalate, load growth can decline, relative fuel prices can change, new technologies can be introduced, environmental problems can surface, and so on. Further, investors know that if things work out as planned or better, the company will be allowed to earn its cost of capital, but no more, while if things do not work out as anticipated, full recovery may not be permitted. So, when a company begins a major new construction program, that very fact will cause it to lose favor in the capital markets.

Now consider Figure 2. The top section shows the long-run construction expenditure forecast for a hypothetical utility. The company projects a smooth, slowly growing level of expenditures for transmission and distribution facilities, and periodically it must build a new generating unit (or refurbish an old unit). The lower graph shows the equity ratio situation. The long-run target ratio depends primarily on basic business risk, which we assume is constant. However, the actual equity ratio would cycle about the target level, rising when construction activities are low, then declining as the company goes into its peak expenditure period, because peak expenditures would be financed primarily by debt.[8]

The pattern shown in Figure 2 is consistent with both finance theory and with what utilities have been doing in recent years, but several questions are suggested by the graphs: (1) At what level should the long-run target capital structure be set? (2) How far above and below the long-run target should the actual equity ratio go? (3) Should the same targets be used by all utilities? (4) For regulatory purposes, should the target or the

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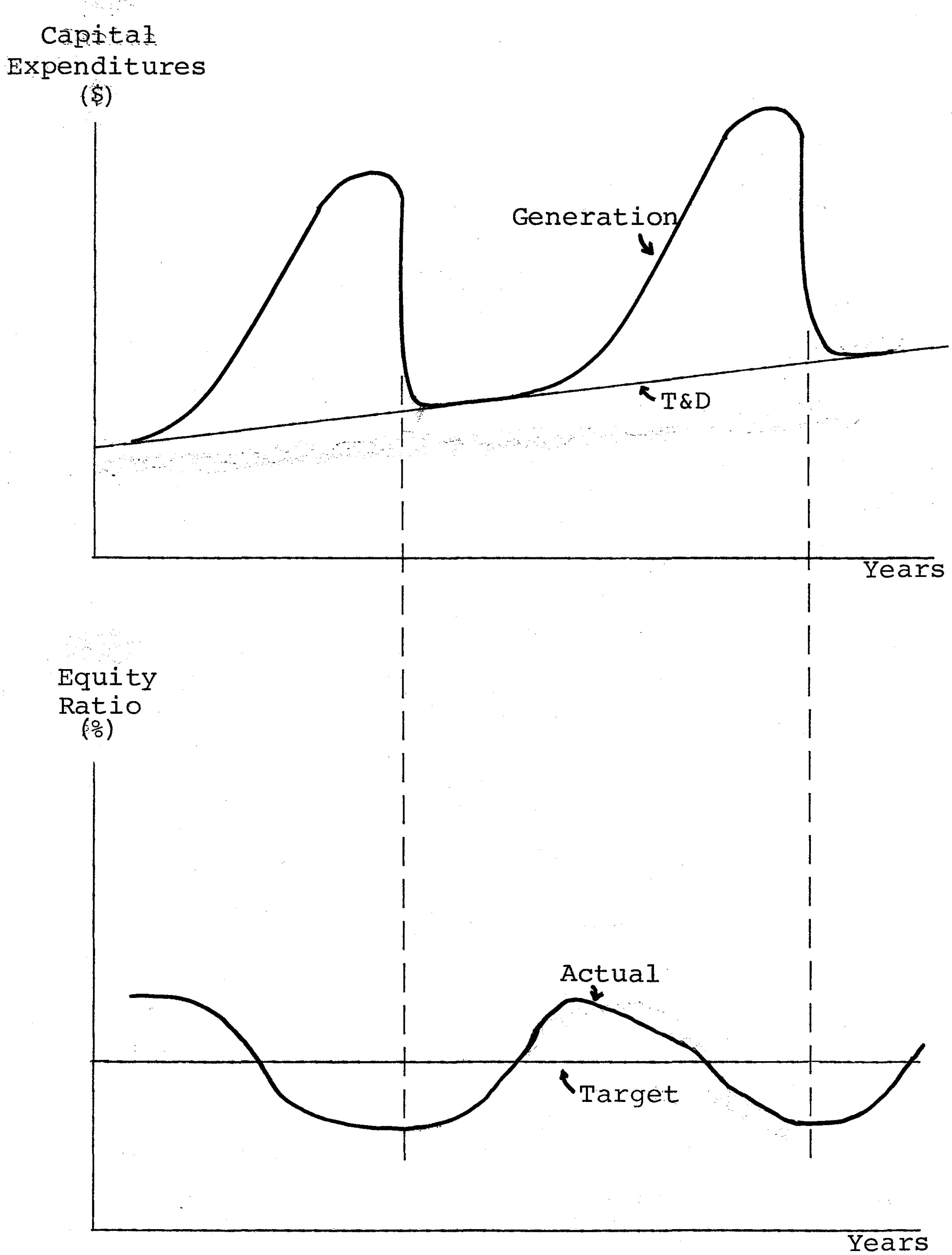
[8]The actual equity ratio would also deviate from the target ratio as a result of varying conditions in the debt and equity markets, bond maturities, refunding opportunities, and the like. Also, as diversification becomes more important, opportunities outside the utility will probably influence holding company decisions with regard to the utility's payment of dividends to the parent, and hence both the utility and the consolidated capital structures.

Figure 2
Relationship between Construction
Expenditures and Capital Structure



actual capital structure be used to determine the allowed rate of return? These points are addressed next.

1. The long-run target. It is extremely important for a utility to be able to raise capital under adverse conditions, and investors look to bond ratings as a guide to a company's creditworthiness. Putting those two facts together suggests that the long-run target, under 1986 conditions, should be consistent with the guidelines for an AA bond rating. The debt ratio guideline for AA is 39-46 percent, with a 42.5 percent midpoint. Since the average electric uses 10 percent preferred stock, that implies a common equity ratio of from 44 to 51 percent, with a midpoint of 47.5 percent.

The virtual impossibility of "proving" what the optimal capital structure is, combined with the fact that a company's own circumstances have a bearing on its optimal capital structure, suggests that considerable scope should be allowed for managerial discretion. Still, a long-run target equity ratio of 47.5% ± 3.5% seems reasonable for most electric utilities. On the same basis, the target ratio for the telcos should be within the range 62.5% ± 2.5%. Note, though, that conditions in the telecommunications area are especially volatile, making it important that the capital structure target be reviewed periodically.

2. Deviations about the target. Deviations from the target capital structure will occur because of such random factors as bond maturities and capital market fluctuations, and because of construction cycles. Such deviations are necessarily company

specific--for example, a relatively small electric company would normally experience wider capital structure ranges than a larger company because a new plant would represent a larger percentage of the small company's total capital. Still, it would seem prudent to plan to keep the common equity ratios at least in the A range, which for electrics is from 38 to 46 percent. At the high end, we would question the merits of an electric having an equity ratio above the low 50s on the grounds that it would be giving up substantial tax savings and getting little in return.

3. The regulatory capital structure. Assuming a company is operating within a reasonable range, its actual capital structure (or the one forecasted during the period when rates will be in effect) should be used for ratemaking purposes. This would minimize the long-run cost of capital, because investors have more confidence in the impartiality of regulation when they see actual as opposed to hypothetical data being used.

Proposed Tax Law Changes

Four aspects of the pending tax legislation could affect the relative costs of debt and equity, and hence capital structure decisions: (1) corporate tax rates, (2) personal tax rates, including the differential between capital gains and ordinary income, (3) depreciation rates, and (4) investment tax credits.

Our Lotus 1-2-3 model makes it easy to analyze effects of changes in the corporate rate--we simply change rates and run the model. The Senate has proposed a top corporate rate of 33 percent and the House 36 percent, so we ran our model with a 35 percent rate. Table 3 showed that capital structure under existing tax rates makes little difference to customer bills, and the difference would be even less under the proposed rates. Here are the projected 2001 bills with the higher and lower equity ratios:

	Bill for 1,000 KWH Residential Customer	
	46% Corporate Tax Rate	35% Corporate Tax Rate
New target: 47% equity	\$195.70	\$187.67
Base case: 42% equity	194.87	187.35
Difference	\$ 0.83	\$ 0.32

The benefit of debt is its interest tax shelter, and if tax rates decline, so does the value of that shelter. Therefore, whatever the optimal capital structure is under current tax rates, a higher equity ratio will be called for if corporate tax rates are reduced.

The effects of changes in personal tax rates are harder to analyze, but these points are relevant:

1. Under current law, dividends are taxed at a top rate of 50 percent, as is interest. However, capital gains are taxed at a top rate of 20 percent, and that tax can be deferred indefinitely. The capital gains differential reduces the cost of equity relative to debt.

2. Under the proposed law, the rate applied to interest and dividends would decline, but that would not affect the relative costs of debt and equity. However, the proposals would eliminate or at least reduce the capital gains differential, and that action would, other things held constant, reduce the tax advantage of stock vis-a-vis debt and raise the relative cost of equity. For example, if the differential cost of equity over debt were currently 5 percentage points (for example, 14 percent for equity versus 9 percent for debt), the differential might fall to 4.75 percentage points. Really though, we have no way of quantifying this effect.

The bottom line is that if the capital gains differential is eliminated or drastically reduced, the cost of equity will probably rise relative to debt, but we do not know by how much.

It is also hard to estimate the effects of the proposed changes in depreciation allowances and tax credits. Since utilities are capital intensive, those changes--which would reduce depreciation allowances and eliminate investment tax credits--would reduce cash flows and raise revenue requirements. However, they would have no obvious effects on the relative costs of debt and equity, and hence no obvious effects on the optimal capital structure.[9] One might argue that the reduced cash flows under the proposed changes would force companies to rely more heavily on external capital to finance construction programs, and that as a result they should build up somewhat more equity between major construction programs. However, our study provides no information on this point.

On balance, the proposed tax changes might increase slightly the optimal equity ratio, but at this time we see no reason to alter our recommended capital structure ranges.

Conclusions

Our purposes in this study were (1) to examine the effects of capital structure on the cost of equity and (2) to consider the proper range of capital structures for Florida's utilities.

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[9] The depreciation/tax credit changes would raise utilities' effective tax rates, but those rates are not the ones that should be built into a capital structure/cost of capital analysis. The relevant rate is the marginal tax rate, and that (currently) is 46 percent for most utilities, even if their average (or effective) rate is much lower, say 20 percent.

We examined past theoretical and empirical studies bearing on these issues, we performed some empirical studies of our own, and we developed a computer model which permitted us to study the effects of alternative capital structures on revenue requirements and customers' bills.

Our primary conclusion is that capital structure decisions, within the range over which most utilities operate, have only minor effects of revenue requirements. Operating decisions, on the other hand, can and do have a major effect on revenue requirements. This suggests that capital structure decisions should be focused primarily on insuring that financial constraints do not hinder operations.

Although each company's own operating conditions influence its optimal capital structure, certain generalizations can still be drawn from our study. First, the electric utilities should establish long-run target common equity ratios within the range of 44 to 51 percent, with a midpoint of 47.5 percent. This is the guideline range for an AA bond rating, assuming the company also uses about 10 percent preferred stock, and it would provide reasonable assurance that the company could raise capital on favorable terms under most conditions. The target equity ratio range for the Group III telephone companies should be from 60 to 65 percent equity, with a midpoint of 62.5 percent. These targets would, of course, change if economic conditions changed.

The electric utilities go through major construction cycles, and their actual capital structures should vary around their long-run targets depending on where they are in the construction cycle. When a major plant is completed and placed in the rate base, internally generated cash flows exceed construction expenditures, and the equity ratio should be built up and allowed to peak just before the start of the next major construction program. During construction, the company should finance heavily with debt, resulting in a debt ratio peak just as the construction program is completed.

We found that the cost of equity for an electric company changes by an average of 12 basis points per percentage point change in the common equity ratio, assuming the company is within the 40 to 50 percent equity ratio range. The basis point change is smaller in the high end of the equity ratio range, so an increase in equity from 49 to 50 percent would only lower the cost of equity by about 7 basis points, but an increase in the ratio from 40 to 41 percent would lower the cost of equity by about 15 basis points. Both theory and the available evidence suggests that the same general situation would also exist for the telcos, but within a higher equity ratio range.

Finally, we considered the effects of pending tax legislation. The direct effect of the proposed changes would be to reduce the benefits of debt and therefore increase the optimal equity ratio. However, indirect effects which cannot yet be measured would offset at least some of the direct effects. On balance, our analysis suggests that the tax law changes, whatever they turn out to be, will not have much of an effect on the target capital structure.

APPENDIX A
THE CHANGING BUSINESS RISK ENVIRONMENT

As we began our study, it became obvious almost immediately that the effects of financial leverage on both the cost of equity and on the optimal capital structure are dependent upon business risk, defined as the uncertainty inherent in projections of a firm's future operating income.[1] The greater its business risk, the greater the impact of a given change in financial leverage on the cost of equity, and the greater the business risk, the higher the equity ratio should be. Thus, we must address the issue of business risk. Ideally we could develop an index of each company's business risk over time. Then, we could compare different companies and also see how a given company's business risk has changed over time.

Unfortunately, we were unable to develop any type of business risk index. The problem is that we need some measure of future uncertainty. Normally, one would use a standard deviation or a similar statistic for this purpose, but the very nature of business risk makes it impossible to use statistics for measurement purposes. For example, how could one measure the effect of the AT&T breakup on the telephone companies' operating incomes before the full effects of the breakup are known?

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[1]For example, see E.F. Brigham and L.C. Gapenski, Intermediate Financial Management (Hinsdale, Ill.: Dryden Press, 1985), Chapter 6.

Even though we cannot quantify and measure business risk, it still exists, and we can still form judgments about how it varies across companies and over time. This appendix presents some thoughts on that subject.

Background

During the 1950s and early to mid-1960s, utilities were viewed as being significantly less risky than most unregulated companies. However, during the 1970s all electric, gas, and telephone utilities were hit by high inflation and regulatory lag. The electric and gas companies faced additional uncertainties about future demand, fuel cost and availability, environmental requirements, increased governmental regulations, and nuclear problems. The gas industry was faced with rising energy costs, deregulation, and strong competition from fuel oil. The telephone industry was exposed to ever increasing competition, hit with by-pass resulting from regulators' failure to realize that a competitive industry cannot subsidize any large class of customers (residential), and faced with the prospects of having to writeoff assets that had been depreciated too slowly.

Many parties suffered from these events. Electric customers saw their rates soar, while stockholders saw stock values eroded by 50 percent or more, and by far more in real terms. Bondholders suffered similar losses, and a number of utility managers and regulators were forced into early retirement when problems got out of hand. The situation was similar in the gas and telecommunications industries.

Of course, the ride has not been all downhill. Since the early 1980s conditions have improved for all the utilities, including stockholders, managers, regulators, and customers.

Where do we go from here? Have utilities returned to the safe, stable companies that they were in the 1960s and earlier, or is their recent improvement simply a reflection of favorable conditions in the economy as a whole? And what effect does the answer to this question have on the type of capital structures the utilities should move toward, or perhaps maintain? We explore those questions in this appendix.

Electric Industry

As compared to most unregulated companies, electric utilities have extremely long investment time horizons. It takes 8 to 10 years to plan and then to build a major coal plant, and the plant will normally have an operating life of about 30 years. Thus, the total planning and operating horizon is about 40 years for a coal plant, and even longer for a nuclear plant.

In a dynamic, changing economy, it is extremely difficult to predict where people and industry will locate, how much power they will require, absolute and relative fuel costs, technological developments, environmental requirements, and the like. Although both industrial and utility companies face similar uncertainties on a year-to-year basis, the electric utilities are hostage to future events over a much longer period than the industrials, and it is obviously easier to forecast events for 5 to 10 years than over a 35- to 40-year horizon.

Demand Uncertainties

Electricity has traditionally been considered a necessity, hence demand for it has been relatively stable. However, both conservation and increased costs have led to higher elasticity of demand for electric utility services and, consequently, increased the electrics' difficulties in forecasting future demand.

In the past, plants could be built in only a few years, so companies could wait until demand was reasonably assured before starting construction of a new plant. Now construction times have lengthened, annual growth is slower, and greater uncertainty exists about future demand. Moreover, a company that builds a plant which subsequently turns out to be not fully needed when it is completed faces risks of disallowances or other penalties. So, all things considered, utilities face far greater risks when they embark on a major construction program than they did in the past.

Fears of fuel shortages and uncertainty about fuel prices are also problems. The current oil pricing questions, recurring strikes or threats of strikes in the coal industry, and general (and continuing) questions about the availability and/or costs of natural gas, nuclear fuel, and coal suggest that this uncertainty will continue. All of this compounds the forecasting problem by introducing a risk that the wrong kind, as well as the wrong size, of plant will be built.

Pollution Control Requirements

Fears about the ultimate impact of the evolving pollution control requirements have increased the electrics' risks and uncertainties even more. Both the installation and the operation of pollution abatement equipment are expensive. Moreover, an electric utility may install equipment that meets existing standards only to be required to retrofit such equipment a few years later because the standards have been changed. Because of acid rain problems and the emerging concern over ozone depletion in the upper atmosphere, there is even a chance that some coal fired plants may have to be retired prior to expiration of their useful lives. Indeed, who can say today what the impact of environmental problems may be on the utility industry 10 years from now, or who will have to bear the costs if massive writeoffs or retro-fits are required?

Earnings Quality

The quality of electric utilities' reported earnings has also deteriorated to some extent. In essence, quality involves both predictability and liquidity. Predictability encompasses both volatility over time and the chance of a permanent erosion of earnings power, while liquidity refers to cash available for current use. Most electric companies' earnings have become more volatile in recent years, and electric utilities are also exposed to the risk of long-run earnings declines.

Earnings quality reflects a number of different factors. First is the matter of financial leverage--how much debt and preferred stock has claim to the company's income ahead of the common stockholders? If a great deal of debt and preferred is at the head of the line, then even a small decline in operating income can cause low or even negative earnings for the common stockholders. The second quality factor relates to the source of the earnings, whether from operations or from the accountant's pen. Electric utilities get income (1) by producing electricity and (2) by multiplying an allowed AFUDC rate times that portion of the Company's construction work in progress which is not included in the rate base:

Addition to reported income,
called Allowance for Funds Used = (AFUDC rate)(CWIP).
during Construction (AFUDC)

AFUDC income is not cash, so it cannot be used to pay interest or dividends.

The best way of measuring earnings quality, as well as the exact impact of earnings quality on the cost of capital, has been hotly debated. However, there is no question about the facts that earnings quality does indeed have a significant impact on the cost of capital, and that the electric utility industry has been negatively impacted by periodic high ratios of AFUDC to net income.

Earnings quality fluctuates over time--while a company is building a major generating plant, its AFUDC is likely to be high and its earnings quality correspondingly low, but earnings quality generally increases after the plant goes on line. The exception is where phase-ins are required. Today, earnings quality is relatively high for the average electric company because construction programs on average are down. However, investors learned during the 1970s that earnings quality erodes when construction activity is high, so if it appears likely that construction will pick up--either for capacity to meet growing demand or for pollution abatement--then fears regarding earnings quality will be rekindled.

The quality of earnings issue is especially important for those companies that have non-earning assets, because the accounting profession is currently discussing changes in the rules governing the treatment of such assets (FASB #71). These changes could cause major reductions in both reported earnings and book equity for a number of companies.

Operating Leverage

Business risk also depends on operating leverage, which is defined as the extent to which costs are fixed. The electric utility industry is more capital intensive than any other major industry, even the telecommunications industry, so more of its costs are fixed than is true of other industries. Therefore, if demand falls, profits are squeezed to a greater extent than is true in other industries. As a result, operating leverage tends to raise the electric utilities' risks, hence their costs of capital, vis-à-vis those of unregulated companies.

If an electric utility's load growth forecasts are incorrect, and it builds either too much, too little, or the wrong type of plant, then it could face problems in the marketplace. Even if its regulators were willing to allow it to pass all costs on to consumers, the market might simply not be willing to buy sufficient quantities at the required prices for the company to recover its costs. The electrics' high degree of operating leverage magnifies the problems associated with incorrect forecasts.

Nuclear Construction and Operating Risks

The Three Mile Island and Chernobyl accidents; the Zimmer, Shoreham, and Marble Hill situations; problems with other operating plants; questions about nuclear waste disposal; and referendums advocating the closing of nuclear plants have all heightened investors' awareness of the potential risks related to nuclear plants. New plants may not be licensed; existing plants may be closed either permanently or for prolonged modifications; and future decommissioning costs may end up exceeding currently estimated costs. Because of these factors, electrics with large investments in nuclear plants are regarded by investors as having especially high risks, hence high capital costs. Investors recognize, especially since the Three Mile Island accident, that any nuclear utility could be devastated by a similar accident. Even a less serious accident, or a required modification unrelated to any accident, could raise an electric's required investment and/or force it to purchase power that is far more expensive than the nuclear power being replaced, and full recovery of either of these two types of expenditures is uncertain.

Telecommunications Industry

Throughout most of its history, the telephone industry conducted business as a regulated monopoly. The Bell System, the largest segment of the industry, functioned in a coordinated fashion. The operating telcos would forecast demand for their services and report this to AT&T, which, through Bell Labs and Western Electric, would design, manufacture, and install the equipment needed to meet the forecasted demand. Because competition was absent, the demand forecasts were relatively accurate--there was not much danger of missing the forecast badly and consequently ending up either with a great deal of excess capacity or with a major shortage of capacity. Investment in installed plant could be recovered through depreciation charges built into service rates over the life of the relevant plant. Plant lives were based on physical depreciation and technological obsolescence. Physical depreciation was relatively easy to measure, and technological obsolescence was controllable. Therefore, the telcos did not have to worry about having to retire from service plant with costs that had not been fully recovered through depreciation, and regulatory commissions permitted the telcos to charge rates which provided a fair rate of return on invested capital.

National policy, which also had the blessings of the state regulatory commissions, called for universal telephone service. Moreover, value-of-service pricing concepts (as opposed to strict cost-of-service pricing) were used to help meet this goal. Under those pricing policies, the Bell System and other telcos (1) allocated an especially high percentage of common costs to long distance service, (2) charged business users relatively high rates, and (3) earned relatively high profits on terminal equipment sold to business users. All of these practices were designed to hold down the costs to local residential customers; in effect, business subscribers and long distance users were subsidizing local residential subscribers.

That system began to break down in the 1960s. Technological developments in long distance transmission and switching changed the cost structure so that competition in long distance became feasible. Further, non-Bell manufacturers were able and willing to offer terminal equipment that (under the FCC's registration program) was compatible with the telephone network. Thus, it became technically feasible, without a substantial cost penalty, to permit competition into major segments of the telephone industry. Gradually, the substitution of competition for regulation became a national telecommunications policy goal, and competition was indeed introduced, in stages, beginning in the late 1960s.

Mandatory Investment

The telephone utilities' plant and equipment investment is mandatory. Telephone utilities are required to provide a reasonable level of basic telephone service to all new and existing customers in their service areas. Both industrial firms and the non-franchised segments of the telephone industry, however, have no obligation to expand--they can defer expansion, abandon unprofitable products or markets, and, in general, gear their operations to internal and external conditions. Moreover, if these unregulated companies are uncertain about the long-run situation, they can simply wait to see whether a given spurt in demand is permanent or temporary and, thereby, reduce the risk of building excess capacity. Perhaps even more important, if an unregulated company takes a chance, invests heavily in an uncertain market, and turns out to be correct, it can earn returns which far exceed its cost of capital. The chance for high profits thus offsets the chances of loss if demand turns out to be low.

To meet mandatory service requirements, the telephone utilities must go forward with their construction programs, investing large amounts of money in needed equipment. This capital investment must be made even in times when current returns are below the cost of capital. Further, unlike the situation with unregulated companies, it is difficult for a telephone company or other regulated utility to make up in good times return shortfalls experienced during bad times. Of course, a telephone utility could not, in the long run, fulfill its obligation to serve its customers unless regulators allowed it the earnings and cash flow necessary to fulfill that obligation, but shortfalls can and do occur in the short run, and the "short run" could, under certain circumstances, last for 20 or more years.

Competition

The introduction of competition in the telecommunications industry has had, and will continue to have, many benefits to the economy, but it also has brought about major changes which have a direct bearing on the risks faced by investors and telephone companies. Under competition, there are two elements of uncertainty in demand forecasts--size of the total market and market share. Formerly, a telco could forecast the total market in its geographical area and then build to meet that demand. Now it must also forecast its market share, which can be extremely difficult. In the past, prices were set on a cost-plus-profit basis, with the profit being designed to provide a fair rate of return on invested capital. Today, and certainly in the relatively near-term future, prices will to a large extent be set by competition.

Those segments of the telecommunications business which under regulation earned the highest returns--long distance and terminal equipment--are the segments which are being released from regulation. Therefore, returns in these areas are being driven down to "normal" levels by competition, so relatively high profits here will no longer be available to subsidize local residential customers. This means, of course, that local residential telephone rates will have to be increased by enough to offset both the erstwhile subsidies and the continuing inflation-induced cost increases.

Depreciation

The effects of deregulation on depreciation charges are also important. Previously, when Bell Labs, Western Electric, and the telephone companies operated in a coordinated manner, new technology could be introduced in a planned, controlled manner that was also coordinated with depreciation schedules on the embedded plant. Thus, a particular switch might have been depreciated over a 30-year life, with the cost of the switch being recovered from customers through service rates over the same 30-year period. There was not much danger that the switch would be retired before the end of its projected life, hence little danger that the cost of the switch would not be fully recovered. However, with the introduction of competition, the danger of early retirement and less than full recovery has become much more of a threat.

Technological Advances

Now consider the joint effects of technological change and competition. If new technology which cuts costs and/or improves service is developed, then in theory telcos can either install it or not. However, if they do not, then their competitors most certainly will, and the competitors will then be able to provide better, lower cost service. Therefore, if a telco wants to maintain its market, competition will force it to use the new technology when it becomes available. But what about the telco's old, technologically obsolete embedded plant? Part of the cost of that plant has not been recovered through rates. Can the telco continue either to build a depreciation charge on that old equipment into rates or to write it off and simultaneously bill current customers for the writeoff? Not under competition. If under competition a telco attempted to raise rates to recover a shortfall of past depreciation charges, its customers would simply switch to one of its competitors, whose rates would not be burdened with writeoffs on old equipment.

Firms in industries that have always been competitive have long recognized that technological advances, as well as physical wear and tear, limit the useful lives of their equipment, and they have built this into their depreciation schedules. Consequently, the book assets of most industrial firms reflect replacement costs and market values with a fair degree of accuracy. Unfortunately, the same thing does not hold true for the telcos. Because regulators have had to approve their depreciation schedules, because faster writeoffs would raise current service rates, and because regulators have historically sought to hold down rate increases, the changing economic environment has not been adequately reflected in depreciation rates on telephone plant.

This situation was made dramatically clear during the AT&T breakup, as questions arose regarding which entities were to receive what specific items of equipment. Obviously, neither the new AT&T nor the spun-off operating companies wanted to receive more than a "fair share" of under-depreciated equipment. In December 1983, just before the breakup was finalized, AT&T wrote off over $5 billion of the assets it had received, so obviously its executives believed that it possessed some over-valued assets. Many investors are concerned that other telcos may face a similar problem, and that they may have difficulty obtaining timely rate increases to deal with this factor. Even more important is the question of what will happen in the future. Will the telcos be permitted to writeoff new and existing equipment over realistic lives? From an investor's standpoint, this is a very serious risk, and the greater the degree of competition, the greater the risk.

By-pass

Telephone companies face yet another potentially serious problem, that of by-pass, the term used to describe the situation in which a customer leaves the telephone network for a major portion of its telecommunications services. As noted earlier, historically other classes of customers have been required to pay rates which subsidized local residential users. This presented no problem in the past, when the industry was a monopoly. The "overcharged" customers could complain, but they could not leave the system--they needed telephone service, and they could get it only from their franchised telephone company. That situation changed with regard to long distance and terminal equipment in the 1970s, and it will continue to change in other segments of the business in the years ahead.

The business market is especially vulnerable to by-pass. Increasingly, banks, insurance companies, retail chains, manufacturers, and the like are installing their own networks for internal communications, including the rapidly expanding data transmission business. Thus, they are by-passing the existing telephone network for a major part of their telecommunications needs.

As developments in new technology continue, by-pass may well accelerate. However, the rate at which by-pass increases will depend on the telcos' rate structures. If their business rates continue to be set well above residential rates in an attempt to provide subsidies for local subscribers, this will accelerate by-pass. Moreover, if high-volume, high-profit users left the system, the remaining customers will have to pay still higher rates to cover the system's fixed costs. This, in turn, will lead to still more by-pass, resulting in a spiral that could become absolutely unmanageable.

To the extent that by-pass occurs in the future, it will have a direct effect on a telco and/or on its remaining customers, the revenues that are lost must either be made up by other customers or else profits and the earned rate of return will be reduced. By-pass also has a secondary effect--the greater the degree of actual or potential by-pass, the more serious will be the effects of inadequate depreciation rates as discussed in the preceding section. For example, suppose an asset with a cost of $2,000 is installed, and it is set up with a 20-year depreciable life, or $100 per year. Five years later, it is recognized that the 20-year expected life was too long--the actual usable life will be only 10 years. Accordingly, the $1,500 undepreciated balance must be depreciated over 5 years, so depreciation expenses, and hence the depreciation component of customers' bills, should rise from $100 to $300 per year. Suppose now that certain classes of customers had the potential for by-passing the system previously, but it was marginally unprofitable for them to do so. However, following the rate increase resulting from the depreciation increase, by-pass for these customers might become profitable. This would obviously add to the telcos' problem. Thus, we see that inadequate depreciation rates and potential by-pass in a competitive environment have a combined effect that is worse than the effects of each problem taken separately.

Political Considerations

From an investment viewpoint, the telcos today face yet another problem. When terms of the Modified Consent Decree that controlled the AT&T breakup were being negotiated, many state regulators and consumer groups lobbied to help operating telephone companies obtain permission to engage in certain unregulated competitive activities. Control of the Yellow Pages is a prime example. The expressed purpose of these efforts was to help the telcos earn additional revenues which could then be used to subsidize local residential customers. Therefore, if the telcos should invest capital in some unregulated activity, and if that investment should earn a high rate of return, it might be expected that regulators would seek ways to lower the rate of return authorized on regulated assets.

Note, however, that in the competitive, unregulated sectors of the economy, some ventures generate very high returns (30 percent or more) while others result in losses. Diversified corporations, or even individual investors who hold portfolios of diversified stocks, can expect to have both "winners" and "losers," and on average to earn a relatively high rate of return on their invested capital. But what about a telco? If it is diversified, and if its non-regulated assets "hit," the profits can be siphoned off and used to subsidize customers. However, if the diversified investments "miss" and thus incur losses, commissions are unlikely to let the company pass those losses on to its telephone subscribers. Thus, an investor has reason to fear that the telcos will end up in a game of "heads I win, tails you lose."

All of the factors discussed above--mandatory investment, political considerations, competition, by-pass, inadequate depreciation, and so on--are very important issues, and these factors have heightened uncertainties in recent years about the telephone utilities' future performance. Put another way, they have increased the industry's business risk.

Natural Gas Industry

The situation facing natural gas distribution companies is generally similar to that facing the electric and telephone companies. For gas companies, the key uncertainties relate to the long-run supply of and cost of gas vis-à-vis competitive fuels, especially fuel oil. Our national gas policy is in a state of flux. At this point, we do not know who will be allowed to charge what for gas, what the long-run availability of gas will be, or, consequently, what the supply and cost of gas to gas utilities' customers will be. This uncertainty obviously concerns both users and investors, and it increases the gas utilities' business risk.

For many years, natural gas had a significant cost advantage over fuel oil. However, the recent weakness in oil prices has changed this situation and has led to increased competition between gas and oil. This has increased both the short-run volatility and the long-run potential for loss of market share faced by gas companies, and hence has increased their business risks.

Conclusions

For the reasons set forth above, it is clear that the electric, gas, and telephone companies are all exposed to more business risk today than they were in the 1960s and earlier.

Although times are currently good for most utilities, that does not mean that their business risk is down--it just means that things have gone well recently.

Finance theory, as well as common sense, suggest that the higher a company's business risk, the higher its optimal equity ratio. Thus, the utilities should have stronger capital structures than they did in the past. Exactly how strong will be explored elsewhere in the report.

APPENDIX B
CAPITAL STRUCTURE THEORIES

Finance theory can provide insights into the determinants of an appropriate capital structure, but the theory cannot tell us precisely what a firm's capital structure should be. A quotation from Professor Stewart Myers' 1983 Presidential Address to the American Finance Association summarizes the situation:

> We know very little about capital structure. We do not know how firms choose the debt, equity, or hybrid securities they issue.... There has been little if any research to test whether or not the relationships between financial leverage and investors' required return is what theory would predict. In general, we have an inadequate understanding of corporate financing behavior, and of how that behavior affects security returns.
>
> I do not want to sound too pessimistic or discouraged. We have accumulated many helpful insights into capital structure choice.... We have thought long and hard about what these insights imply for optimal financial structure. Many of us have translated these theories, or stories, of optimal capital structure into more or less definite advice to managers. Yet our theories don't seem to explain actual financing behavior, and it seems presumptuous to advise firms on optimal capital structure when we are so far from explaining actual decisions.[1]

Myers' statement is absolutely true--finance theory can provide useful insights regarding an appropriate capital structure, but one cannot use finance theory to specify an optimal capital structure. Put another way, capital structure decisions must be

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[1]See Stewart C. Myers, "The Capital Structure Puzzle," Journal of Finance, July 1984, 575-592.

made on the basis of informed judgment rather than by mathematical formulas, but finance theory can provide helpful insights for judgmental decisions. In this appendix, we discuss various capital structure theories and their application to energy and telephone utilities.

Introduction to Capital Structure Theory

Capital structure theory has been developed along two major lines:

1. Tradeoff of Tax Savings Benefits versus Costs of Financial Distress. The tradeoff theory is associated with Nobel Prize winner Franco Modigliani and Merton Miller (MM), and it postulates that the optimal capital structure for a firm can be established by examining the benefits of leverage resulting from our tax laws versus the drawbacks of leverage associated with various aspects of financial distress.
2. Signalling, or Asymmetric Information, Theory. This theory postulates (1) that managers and investors have different information about firms and their prospects, and (2) that investors generally view an equity offering as a sign that the issuing firm's prospects are not bright, and hence (3) investors mark down the price of its stock and consequently raise its cost of capital when a firm announces a new stock offering. From this it follows that firms should use less debt than they potentially could during "normal" times so as to build a "reserve borrowing capacity" which can be used in lieu of equity at times when more funds are needed than can

be raised from internal sources plus normal debt financing. In public utility terminology, this would be called "maintaining financial integrity."

Both theories have merit, and both should be taken into account when establishing capital structure policy.

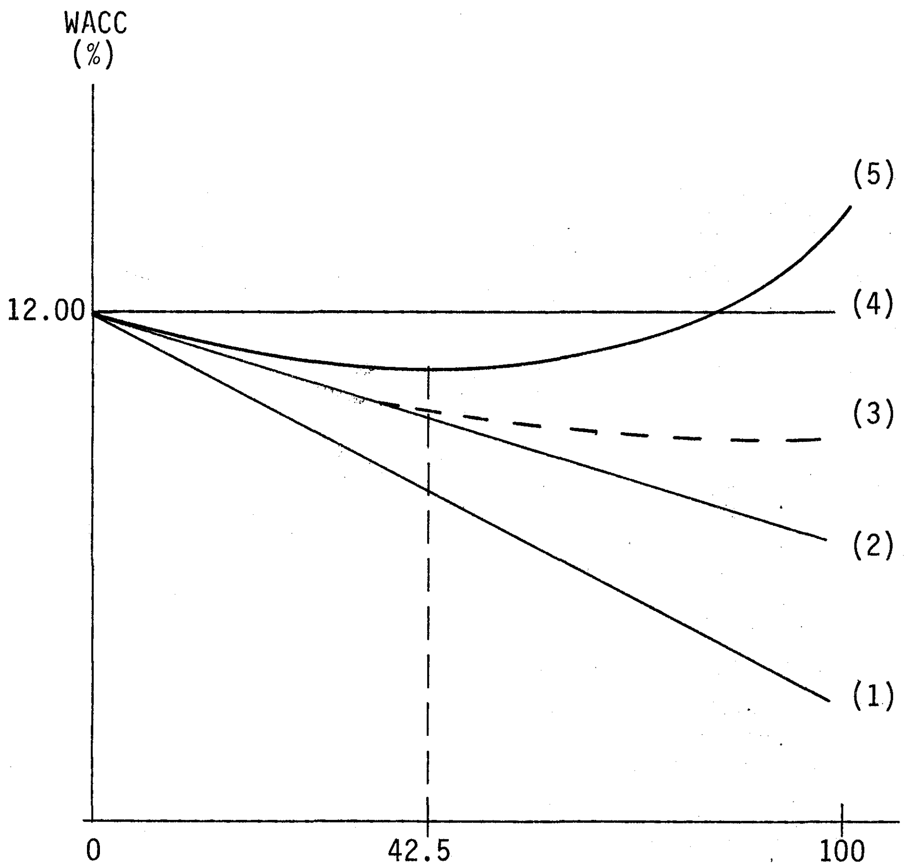
Tax Savings Tradeoff Theory

The tradeoff theory leads to the conclusion that there is an optimal capital structure for each firm, and that this optimum is established at the point where the positive tax benefits associated with debt financing are exactly offset by the negative costs associated with the possibility of financial distress. This theory dates back to 1958, when the first MM paper was published, although substantial modifications have been made by MM and others during the past 28 years.

Figure B-1 gives a graphic view of the tradeoff theory as it has evolved since MM first introduced it. The vertical axis indicates the weighted average, or overall, cost of capital. We assume that the illustrative firm would have a 12 percent cost of equity if it used no debt and hence had a debt ratio of zero. At a zero debt ratio, all capital would be equity, and hence the weighted average cost of capital (WACC) would be 12 percent:

$$\begin{aligned} \text{WACC} &= \begin{matrix}\text{Fraction}\\ \text{of debt}\end{matrix} \times \begin{matrix}\text{Cost}\\ \text{of debt}\end{matrix} + \begin{matrix}\text{Fraction}\\ \text{of equity}\end{matrix} \times \begin{matrix}\text{Cost}\\ \text{of equity}\end{matrix} \\ &= 0(\text{Cost of debt}) + 1.0(12\%) \\ &= 0\% + 12\% \\ &= 12\%. \end{aligned}$$

Figure B-1
Illustrative Graph of the Tax Savings
versus Financial Distress Tradeoff Theory



(5) WACC considering all tax and financial distress effects. This curve nets the benefits against the costs of using debt. It represents the position of most academics.

(4) Miller position: WACC not affected by capital structure; personal tax effects offset corporate tax effects.

(3) Modified Miller view, but recognizing that the expected corporate tax rate will fall as the debt ratio rises, lowering the expected tax shelter benefits of debt.

(2) Modified Miller view, netting personal tax benefits of equity against corporate tax benefits of debt, but with no consideration of financial distress.

(1) MM position considering corporate tax shelter benefits only.

As the firm uses more and more debt, its riskiness increases, driving up the cost of equity. (MM assumed that the risk of financial leverage fell entirely on the equity, so under their theory the cost of debt remained constant. Others relaxed that assumption, but MM never did.) Under their model the cost of equity increases at a rate which forces the WACC to remain constant regardless of capital structure changes. Thus, their major conclusion in 1958 was that capital structure simply does not matter--one capital structure is as good as any other. Line 4 in Figure B-1 shows MM's 1958 position.

The MM 1963 Model

In a 1963 extension of their 1958 paper, MM argued that when the tax deductibility of interest is considered, debt becomes less costly on a risk-adjusted basis than equity, so the more debt a company uses, the lower its weighted average cost of capital. MM's 1963 theory suggests that the cost of equity rises as leverage increases, but that the tax saving from the use of debt (which increases as debt usage rises) more than offsets the increasing cost of equity. Line 1, the lowest line in Figure B-1, graphs MM's 1963 view of the WACC. We see that their 1963 theory led to the conclusion that firms should use virtually 100 percent debt.

The Miller Model

The MM models were based on some obviously unrealistic assumptions, and their 1963 conclusion that firms should use 100 percent debt was easy to criticize. Therefore, work to modify that model began almost as soon as it was published. The Miller half of the MM team concluded, in his 1977 Presidential Address to the American Finance Association, that when personal as well as corporate taxes are brought into the analysis, capital structure has no effect whatever on the WACC. Miller's position is represented by the horizontal line, Line 4, in Figure B-1. In essence, Miller argued that corporations' gains from the tax advantage of leverage are exactly offset by investors' personal taxes. His argument went like this. First, interest is fully taxable to taxpaying bondholders, whereas a large part of the income derived from stocks escapes taxation. Because of this differential tax treatment, investors are willing to invest in stocks with a lower pre-personal-tax, risk-adjusted rate of return than on debt. Thus, corporations will save corporate taxes if they use more debt, but the lower pre-tax, risk-adjusted cost of equity resulting from the personal tax advantages of equity offsets the deductibility of debt.

Miller's explanation of the personal tax advantages of equity included these factors: (1) Much of stockholders' income is capital gains, which can be deferred indefinitely, and when gains are finally taxed, they are taxed at low rates. (2) Dividend income is taxed at a maximum rate of 6.9 percent to corporate investors versus 46 percent for interest income. (3) Some dividend income can be excluded by individual investors. (4) Margin debt strategies can be used to purchase stock, with interest payments offsetting dividend income and the net result being only capital gains, which are subject to low and deferred taxes. The result of all this, according to Miller, is Line 4 in Figure B-1.

The Modified Miller Model

Miller's position as set forth above depends on the existence of a precise relationship between the corporate tax rate, the tax on income from stocks (an average of the taxes on dividends and capital gains), and the tax on income from debt (interest). A number of researchers have argued that the various tax rates are such that personal taxes offset some, but not all, of the corporate tax benefits of debt, with the net result being Line 2 in Figure B-1, labeled the modified Miller view.

Corporate Tax Rate Effects

In both the 1963 MM paper and Miller's own work it was assumed that the corporate tax rate is a constant regardless of how much debt a firm uses. Others have observed that the more debt and hence the more interest cost a firm has, the lower its earnings before taxes as a percentage of revenues, and consequently the lower its expected future average tax rate. Since investors know this, they build in a lower tax rate when projecting the future cash flows for a heavily leveraged firm. Since, under all versions of the tradeoff theory, the only benefit from debt is attributable to tax effects, and since expected tax benefits are proportional to the expected future tax rate, the effect of this situation is to reduce somewhat the benefits of leverage as debt increases. Line 3 in Figure B-1 adds the declining expected corporate tax rate effect to the modified Miller position.

The Costs of Financial Distress

All of the points expressed above ignore the effects of potential financial distress. Specifically, MM assumed that corporate debt is riskless, hence that the interest rate a firm pays is independent of its capital structure. This implies that the cost of debt to a firm if it had a 90 percent debt ratio would be the same as if it had a 10 percent debt ratio. MM also ignored the possibility that a highly leveraged firm like Eastern Airlines might lose business to stronger firms such as Delta and American Airlines, or that a strong company like IBM might be able to take advantage of (or to create) business opportunities that a financially weaker firm would have to pass up. Similarly, MM did not take account of the fact that a company with a strong balance sheet might be able to ride out a temporary storm, using new debt that could be issued because of its strong position, while a company with a weaker balance sheet might have to sell stock (or even assets) at distressed prices simply because it had no reserve borrowing capacity. It is impossible to quantify or even to list all of the potential adverse operating effects of a weak balance sheet, but they are certainly real, and they are now recognized by most financial executives and academicians as having material, but unmeasurable, effects on capital costs. The effect of potential financial distress is to raise the WACC, and to raise it at an increasing rate as the debt ratio increases. In other words, the effect of potential financial distress is small at low or moderate debt levels, but it rises rapidly once the debt ratio exceeds some critical level.

When all of the effects discussed above are considered together, the net result is Line 5 in Figure B-1, which nets the personal and corporate tax effects against the costs of potential financial distress. At low debt ratios, financial distress is not very likely and hence the tax benefits effect dominates. As a result, a firm with a low debt ratio can increase its use of debt and thereby reduce its WACC. However, as the debt ratio increases, the threat of potential financial distress increases at an increasing rate, and the expected future corporate tax rate also declines. Both of these factors reduce the advantage of debt. At some point the two negative factors more than offset the advantages of increasing debt, and beyond that point a higher debt ratio results in a higher WACC.

Line 5 in Figure B-1 is the critical one: It considers all tax and financial distress effects, and it is the view accepted by most academicians and financial executives. The minimum point on the line indicates the firm's optimal debt ratio: our illustrative company has an optimal, or cost-minimizing, debt ratio of 42.5 percent.

While most academicians (and financial executives) accept the general relationship set forth in Line 5, disagreements arise as soon as one attempts to quantify the relationship. We do not know what the average investor expects the firm's effective corporate tax rate to be in the future. We do not know what personal tax rates to apply to future interest, dividend, and capital gains income. We have no way of quantifying the consequences of potential future financial distress. Thus, we cannot quantify the relationship between the weighted average cost of capital (WACC) and capital structure. A graph like that shown in Figure B-1 is useful for illustrative purposes, and such graphs appear in most corporate finance textbooks, but the data used to plot them are always hypothetical, because there is simply no way to obtain the required data for real companies.

Even though we cannot obtain the actual data necessary to specify the curves in Figure B-1, we can use a range of judgmental inputs to see what the curves would look like under different assumptions. Most such work that we have seen concludes that the WACC (Line 5) is relatively flat over most of its range, which implies that for all practical purposes, the WACC is not materially affected by leverage over a fairly wide range of debt ratios. For example, it would not be at all unusual to examine a company's situation and conclude that its optimal capital structure lies within the equity ratio range of 35 to 55 percent, but that it makes little difference where within that range the actual capital structure is set.

If the true relationship between cost of capital and leverage were such that the WACC is essentially flat over a broad range of capital structures, and if most firms in a given industry operate within this capital structure range, then statistical studies would show low correlations between capital structure and capital costs. Empirical tests, including the ones discussed in Appendix C, indicate that this situation does indeed exist.

Empirical studies have also shown that firms within industries have widely differing capital structures. For example, Table B-1 presents the means and standard deviations of the common equity ratios for 12 unregulated, non-financial industries. The industry means range from a low of 36.5 percent to a high of 80.9 percent, and the standard deviations range from 11.2 percent to 21.4 percent. Consider the last industry listed, retail grocery stores. The industry average equity ratio is 58.9%, and the standard deviation is 11.2%. This indicates that 68% of the grocery chains have equity ratios within the range 58.9% ± 11.2%, or from 47.7% to 70.1%. Thus, even for the industrial group with the lowest standard deviation, individual firms still exhibit wide variations in capital structures.

Table B-1
Industry Common Equity Ratios

Industry	Number of Companies	Average Equity Ratio	Standard Deviation
Air Transportation	23	36.5%	21.4%
Blast Furnaces and Steel Works	28	63.0	19.7
Electronic Components	24	68.9	19.3
General Industrial Machine and Equipment	28	71.5	15.0
Miscellaneous Plastic Products	20	71.8	18.1
Motor Vehicle Parts and Accessories	22	68.1	15.8
Natural Gas Transmission and Distribution	18	53.6	13.2
Natural Gas Transmission	19	47.0	12.4
Paper and Allied Products	24	59.3	15.0
Pharmaceuticals	16	80.9	14.4
Restaurants	20	63.2	21.0
Retail Grocery Stores	20	58.9	11.2

The differences in the industry averages probably reflect business risk differentials among industries, while the differences between individual firms in each industry probably reflect both managements' inability to measure exactly the optimal capital structure and also the fact that the WACC is relatively flat across a fairly wide range of capital structures.

Now recognize that standard economic theory suggests that if there were a precise optimal capital structure, and if capital structure had an important effect on capital costs, then competitive pressures and/or the quest for higher profits and stock prices would drive firms within each industry toward that industry's optimal capital structure. The fact that firms within industries employ quite different capital structures is strong support for the position that a precise optimal capital structure cannot be identified, and hence that for practical purposes it is better to think in terms of a fairly broad optimal capital structure range rather than an optimal capital structure point.

Signalling, or Asymmetric Information, Theory

In 1961, Professor Gordon Donaldson of Harvard published the results of an in-depth study of a number of large businesses which sought to determine how they actually established their capital structures. Donaldson found that firms use internally generated funds, principally retained earnings, as their first choice, then debt, and that they sold new common stock only as a last resort when they needed to finance exceptionally profitable investment opportunities or to obtain funds for operations when times were extremely bad and constraints precluded further borrowings.

Donaldson's work lay dormant for many years, perhaps because it was inconsistent with the tradeoff theory made popular by MM and their followers. MM's tradeoff theory was specific and yielded testable hypotheses, characteristics that academicians find highly desirable. Donaldson, on the other hand, had provided no rationale for firms' preference for retained earnings and for their strong reluctance to issue new common stock, and without a rationale, it was difficult for academicians to develop tests which would confirm or deny his results.

Recently, though, Professor Stewart Myers provided the missing rationale for Donaldson's results. Myers' argument goes like this: Managers are interested in maximizing the value of their firms' stocks, subject to various legal constraints. This being the case, if some especially good investment opportunities arise, management will want to keep these benefits for current stockholders (including the managers themselves) rather than share them with new stockholders. For various reasons, outside investors often have less information than managers, so a firm's stock price will not reflect highly profitable but unanticipated investment opportunities--it will sell below what management regards as the "proper" price. Thus, if the firm sells stock to finance profitable new projects, then when these projects go on line and begin generating income, the firm's stock price will rise, and the new investors will enjoy an unexpected windfall. The original investors (including the managers) will also benefit, but by less than if the firm had not sold stock before the price rose. This line of reasoning suggests that firms should maintain some "reserve borrowing capacity" in normal times so as to avoid having to sell stock to finance exceptionally good projects. (Of course, all this applies with much more force to a mature, established firm than to a small venture capital type business, especially a company that is going public for the first time.)

Consider also a different situation, where managers see dark clouds on the horizon but investors do not, and as a result the firm's stock sells at a price above the level that management thinks is justified. Under these circumstances, management may elect to issue new stock now, while the price is high, so as to be in a better position if and when the storm does strike. Then, if things do go bad, new stockholders will bear some of the losses and thus dilute the adverse effects on the original stockholders.

Any reasonable investor would expect managers to operate as described in the two cases above--to issue the types of securities that best serve the interests of the existing stockholders, not those of new investors. This, in turn, suggests the following scenario:

1. When a mature firm announces a new stock offering, this could signal either (a) that there are exceptionally good opportunities that can be financed only by issuing stock or (b) that management thinks things look bad, and that the company should go ahead and raise equity before the price

falls. Studies of stock price behavior around the time of stock offerings by mature companies invariably indicate that stock prices tend to decline when new offerings are announced. This applies to all types of companies, regulated and unregulated alike. <u>Thus, investors do interpret the announcement of new stock offerings as signalling bad news.</u>

2. Since stock prices generally decline after a mature company announces a stock offering, this means that equity raised by selling stock is more expensive than retained earnings. Therefore, good financial policy calls for establishing a dividend policy at a level that will provide enough retained earnings to supply all the equity needed to support operations under "normal" conditions.

3. Its target capital structure should include less debt than the amount called for by the tradeoff theory. This "unused borrowing capacity" is, in effect, held as a reserve for use in exceptional times, so as to minimize the probability of having to issue stock.

4. Points 2 and 3 suggest that dividend policy and capital structure policy are interrelated--both should be designed to minimize the need for new equity offerings. Further, if a company has a high payout policy, then its debt ratio should be adjusted downward, and vice versa.

5. Each firm's optimal capital structure (and dividend policy) depends on its own situation, including its probable capital expenditure program and its management's judgment regarding the likelihood of events that would require the raising of

above-normal amounts of capital. The greater the level of expected future capital expenditures, and the greater the uncertainty regarding future operating conditions, the greater the reserve borrowing capacity should be. It should be noted that MM's capital structure theory assumes that corporate capital expenditure programs, capital structure policies, and dividend policies are made independently of one another, not in a coordinated manner. This is fundamentally different from signalling theory, which postulates that these decisions are interrelated.

Both capital structure theories are at least partially correct, so both concepts should be recognized when one attempts either to explain why capital structures are what they are or to recommend a specific target capital structure. Any rational policy must recognize the tax benefits/financial distress tradeoff, but such a policy must also recognize the importance of maintaining reserve borrowing capacity designed to help avoid having to issue stock at inopportune times.

Is Finance Theory Applicable to Utilities?

Because of differences between regulated utilities and unregulated corporations, one might argue that the theories set forth above are not applicable to utilities. Consider first the tax benefits tradeoff theory. One could argue that the tax benefits of debt flow through to consumers, that utility investors need have no fear of financial distress because all costs can be passed on to consumers, and hence that the tax benefits versus financial distress tradeoff theory simply does not apply to utilities. People who hold this view might reason that utilities have little incentive to use debt, because customers rather than stockholders get the benefits, so the companies would tend to use "too much" equity. On the other hand, one could also argue that the companies have no reason not to use very high debt ratios, because they need have no fear of financial distress.

Perhaps there was some truth in either or both of these arguments in the distant past, but they are certainly not valid today. First, note that all utilities face strong competition in major segments of their businesses (by-pass for telephone companies, cogeneration and alternative energy sources for electrics, and both fuel oil and electricity for gas companies). Competition leads to price elasticity, and price elasticity in combination with high fixed costs gives the utilities strong economic incentives to keep all costs as low as possible, including the cost of capital. Thus, utilities have strong economic motives for seeking to find and then operate within the optimal capital structure range.

The argument that utility investors need not fear the effects of financial distress, and hence can use essentially unlimited amounts of debt, is equally hollow. One need only review recent financial history, including stock and bond price performance during the 1970s, to see that financial distress is a very real consideration for utilities. So, utilities' optimal capital structures certainly ought to be influenced by the tradeoff between tax savings and financial distress.

With regard to the signalling theory, industrial companies should maintain reserve borrowing capacity both to avoid having to sell common stock to finance exceptionally profitable projects and also to avoid having to sell stock during difficult times. Utilities, on the other hand, have no opportunities for extraordinarily profitable projects due to rate of return limitations (except for their unregulated subsidiaries). Further, investors have come to expect utilities engaged in major construction programs to issue stock, and to at least some extent investors may still expect regulators to assist companies during troubled times. Therefore, while the announcement of a stock offering should and empirically does generally have a negative effect on a utility, this effect is not as great as the effect of a similar announcement by an industrial company. (Studies of announcement effects confirm this--stock sale announcements put more pressure on industrial stocks than on utility stocks.) As a result, signalling theory suggests that a utility's unused borrowing capacity should, other things held constant, be less than that of an industrial company, and hence utilities' debt ratios should be higher than those of industrial companies with similar business risks.

Summary

In this appendix we discussed two major theories of capital structure, one based on the tradeoff between the benefits of tax savings and the costs of actual or potential financial distress, and the other based on the negative signals investors receive when a company announces plans to issue more common stock. Both theories are logical, and both provide insights into the determinants of an optimal capital structure. Unfortunately, neither theory can, in and of itself, tell us what the optimal capital structure is for any given company.

We also questioned whether or not the theories are really applicable to regulated utilities, and we concluded that they are. While the tax benefits of debt flow through to consumers, the actual and potential competition most utilities face makes it necessary for them to operate as efficiently as possible so as to keep costs at the lowest possible level. Thus, utilities cannot afford to disregard the benefits of debt on the grounds that these benefits accrue to customers, because competition simply will not permit such behavior. Similarly, utilities cannot afford to take on excessive debt on the grounds that regulators will "bail them out" if they get into trouble, and hence that it is safe to disregard the costs of potential financial distress.

Finance theory leads to the conclusion that optimal debt ratios are primarily dependent on business risk and uncertainty about the amount of capital that will be required in the future. These factors are not static over time--they change, and that is especially true of the utilities. The evidence discussed in Appendix A suggests (1) that the business risk faced by most utilities increased during the 1970s, (2) that it is probably lower today than in the recent past for many electric companies, but it is still higher than it was prior to the 1970s, and (3) that business risk is at an all-time high for the telephone companies and perhaps for the gas companies. This suggests that the utilities ought to employ more equity in their capital structures than they did in the 1960s and earlier. Unfortunately, theory only provides insights, not prescriptions. For prescriptions, we need empirical data and simulated results under different scenarios, as we discuss in the following appendices.

APPENDIX C
PRIOR EMPIRICAL STUDIES OF THE EFFECTS OF LEVERAGE ON THE COST OF EQUITY

The theoretical studies discussed in Appendix B led to hypotheses regarding the effect of leverage on the cost of common equity, and these hypotheses have been tested empirically. Because of changing conditions and sample size problems, the empirical studies have not focused on telephone or gas companies, but many of them have analyzed the electrics. This appendix summarizes the most relevant theoretical hypotheses and past empirical studies of results for the electric industry.

Theoretical Hypotheses

The theoretical hypotheses can be divided into three broad classifications: (1) the classic Modigliani-Miller (MM) work, (2) extensions of MM, and (3) adaptations designed to account for regulation. The hypotheses are discussed in that order.

The Modigliani-Miller Model

The theoretical relationships between a firm's use of financial leverage (debt and preferred stock) and its equity costs have evolved from the classic articles by Modigliani and Miller (1958 and 1963). MM began with a set of relatively restrictive assumptions, under which they proved that a levered firm's cost of common equity, k_s, is related to financial leverage in the following way:[1]

[1]Equation 1 is the final result of the MM work when corporate taxes are considered. MM's first article (1958) focused on a zero-tax world.

$$k_s = k_u + (k_u - k_{RF})(1 - T)(\frac{D}{S}), \tag{1}$$

where

k_u = cost of common equity to an unlevered firm with the same business risk as the levered firm,

k_{RF} = cost of risk-free debt to the levered firm,

T = tax rate of the levered firm,

D = market value of the levered firm's debt, and

S = market value of the levered firm's common equity.

In their original work, MM assumed that corporate debt is risk free. However, Stiglitz (1969) and Rubinstein (1973) showed that the introduction of risky corporate debt does not alter the basic MM relationship, which can be rewritten as

$$k_s = k_u + (k_u - k_d)(1 - T)(\frac{D}{S}),$$

where k_d is the incremental cost of risky debt to an unlevered firm. When the levered firm uses preferred stock financing, the relationship expands to

$$k_s = k_u + (k_u - k_p)\frac{P}{S} + (k_u - k_d)(1 - T)\frac{D}{S}, \tag{2}$$

where

k_p = incremental cost of preferred stock to an unlevered firm, and

P = market value of the levered firm's preferred equity.

Equation 2 postulates that the cost of common equity increases with the use of financial leverage, which can take the form of either debt or preferred stock. Further, the relationship is linear when leverage is measured by the ratio of preferred stock or debt to common equity. Note that the values for debt, preferred stock, and common stock must be expressed in terms of market values, not book values. However, if utility commissions attempt to set the allowed rates of return equal to the cost of equity, then over time utilities will on average sell at their book values, so for utilities either book values or market values may be used.

<u>Extensions to the Classics</u>

Financial theorists, including Miller himself, have argued that the basic MM model does not hold when the restrictive assumptions are relaxed. The two most important assumptions in this regard are (1) the absence of personal taxes and (2) the absence of costs associated with financial distress. Miller (1977) and DeAngelo and Masulis (1980) argued that the addition of personal taxes raises the cost of common equity to a level higher than that given by Equation 2. Under the Miller model, the addition of personal taxes results in this relationship:

$$k_s = k_u + (k_u - k_p)\frac{P}{S} + (k_u - (1 - T)k_d)\frac{D}{S}. \qquad (3)$$

Note that the relationship between common equity costs and leverage remains linear when leverage is expressed in terms of market value preferred-to-common stock and debt-to-common stock ratios, but the slope coefficient of the debt leverage term in Equation 3 is larger by the amount Tk_U.

An even bigger criticism of both the MM and Miller models stems from a failure to consider the costs of potential financial distress, which amounts to assuming that such costs are zero. In the event of bankruptcy, or even if the threat of bankruptcy arises, the direct costs of fees paid to trustees, lawyers, accountants, appraisers, and so on, reduce the value of the firm's assets and hence the funds available for distribution to bondholders and stockholders. In addition to these direct costs, firms in financial distress often suffer such indirect costs as lost customers, managerial inefficiency due to preoccupation with financial problems, higher wage demands, and so on. Altman (1984) estimated both direct and indirect bankruptcy costs for a sample of firms and found that these combined costs averaged about 15 percent of total firm value, which means about 30 percent of the value of the equity. Thus, the evidence suggests that expected financial distress costs are sufficiently high to exert a significant influence on the relationship between the cost of common equity and financial leverage. Thus, the MM and Miller models are clearly incomplete.

In addition to bankruptcy costs, Jensen and Meckling (1976) and Barnea, Haugen, and Senbet (1981) argued that the use of leverage imposes costs associated with both the restrictive covenants in debt agreements and the monitoring actions that creditors must take to protect themselves against unfavorable managerial actions. These costs are called "agency costs," and like the costs of financial distress, they increase as leverage increases.

It has been demonstrated (see Chen and Kim (1979) and Kim (1982)) that both financial distress and agency costs invalidate the theoretical relationships developed by MM and by Miller. With these costs added, the relationship becomes much more complex, too complex for theory to lead to any definite conclusions as to the exact relationship between leverage and equity costs.

The Impact of Regulation

It has long been recognized that the process of regulation could affect the theoretical relationships between common equity costs and financial leverage. MM and Miller, in deriving Equations 2 and 3, assumed that earnings before interest and taxes (EBIT) is independent of financial leverage, but others have demonstrated that the regulatory process invalidates this assumption. If operating income were independent of leverage, the effect would be to pass on any tax savings from leverage to stockholders. Gordon (1967) and Gordon and McCallum (1972) argued that if the benefits of debt accrue to customers rather than stockholders, as they generally do in the case of utilities, then earnings before interest but after taxes, rather than EBIT, is the cash flow variable that is independent of leverage. Under this assumption, they argued that, under the remaining MM assumptions, the correct relationship between common equity costs and financial leverage for regulated firms is that prescribed by MM in a zero-tax world:

$$k_s = k_u + (k_u - k_p)\frac{P}{S} + (k_u - k_d)\frac{D}{S}. \quad (4)$$

Elton and Gruber (1971) made the same cash flow independency argument as Gordon and McCallum, but they reached different conclusions. According to Elton and Gruber, the proper leverage relationship for regulated firms is the same as for unregulated firms, given the MM assumptions:

$$k_s = k_u + (k_u - k_p)\frac{P}{S} + (k_u - k_d)(1 - T)\frac{D}{S}. \quad (2)$$

Elton and Gruber (1972) then showed that either Equation 2 or Equation 4 can be correct, depending upon what further assumptions are made about regulatory behavior. Equation 4 is correct if the allowed rate of return, once set, is always earned. On the other hand, Equation 2 is correct if the allowed rate of return is fixed but the earned rate of return is a random variable.

Finally, Jaffe and Mandelker (1976) showed that both the Gordon and McCallum and the Elton and Gruber hypotheses also require specific assumptions regarding the relationship between demand and variability of demand. They argued that an increase in financial leverage will result in tax savings which, under regulation, are passed on to the firm's customers. This results in lower prices and a corresponding increase in demand. For Equation 4 to hold, they argued that the resulting increase in demand variability must be proportionately greater than the resulting increase in demand. For Equation 2 to hold, the level of demand and the variability of demand must increase proportionately. They further argued that traditional economic models assume constant variability of demand, and under this condition, or if the variability increase is less than proportional, then the cost of equity rises less with leverage than indicated by Equation 2.

In summary, finance theory provides many different hypotheses regarding the relationship between equity costs and leverage. The exact specification of the relationship depends on the underlying assumptions. However, we have no way of knowing which set of assumptions is most correct, or indeed if any set of the assumptions is good enough to form the basis for practical decisions.

Empirical Studies

Since the theoretical studies do not agree on the relationship between leverage and the cost of equity, researchers have turned to empirical studies which attempt to estimate the relationship directly. Numerous such studies have been conducted for electric companies, and even more research has been directed toward unregulated firms. We discuss here only the more prominent of the published works on electric utilities.

Virtually all empirical work has used the following specification:

$$k_s = b_0 + b_1(\text{Leverage}) + b_2F_2 + \ldots b_nF_n + e.$$

Here the firm's cost of common equity, k_s, is the dependent variable, leverage is one of the independent variables, and other independent variables, F_i, are included to account for other cross-sectional factors that influence k_s. All studies of this nature have encountered major problems: (1) It is very difficult to estimate the dependent variable, k_s, and hence the early studies often used a proxy such as dividend yield in place of the cost of common equity. (2) The specification must include all other risk factors that are correlated with financial leverage to avoid a bias in the leverage coefficient.[2] (3) All of the variables in the specification should be measured in terms of investors' expectations, yet we generally have available only historical data or limited projected data.

The first major study which incorporated modern financial and statistical concepts was conducted by Brigham and Gordon (1968). They used the following model:

$$\text{Dividend yield} = b_0 + b_1(\text{Growth rate}) + b_2(\text{Book value debt/equity ratio}) + b_3(\text{Earnings instability}) + b_4(\text{Corporate size}) + b_5(\text{Proportion of sales from electricity}) + e.$$

Their sample consisted of 69 electric utilities during the years 1958 to 1962. They found, on average, that a unitary increase in the book debt-to-equity ratio would raise the cost of common equity by about 0.33 percentage points.[3]

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[2]If all of the factors affecting common equity costs were statistically independent, then the omission of independent variables would lower the R^2 of the regression but would not bias the coefficients. However, if variables that are correlated with leverage are omitted, this would result in a leverage coefficient that is either too large or too small, and a standard error that is too small.

[3]A unitary change in the book debt-to-equity ratio is when the ratio changes by $\pm$ 1.0. For example, a change from 0.5 to 1.5 is a unitary change, and such a change would increase common equity costs by 0.33 percentage points. Also, 0.33 is the average

Gordon (1974) expanded both the model and the sample used in his study with Brigham. Here is Gordon's 1974 model:

Dividend yield = b_0 + b_1(Market value debt/equity ratio) + b_2(Growth rate) + b_3(Proportion of sales from electricity) + b_4(Earnings quality) + e.

He found that over the 1958-1968 period, the coefficient of the leverage variable averaged about 0.5 when leverage was measured by the market value debt-to-equity ratio.[4]

Robichek, Higgins, and Kinsman (1973) conducted a study over the 1962-1969 period, using the following model:

k_s = b_0 + b_1((Debt + preferred)/equity ratio) + b_2(Flow-through dummy) + e.

They estimated k_s using several different discounted cash flow (DCF) models, and they used both book and market value leverage ratios. Robichek et al. found that the effect of leverage on common equity costs was about 0.9 percentage points for each unit change in leverage as measured by the book value debt-to-equity ratio. Their results using market value debt-to-equity ratios were inconclusive.

Mehta et al. (1980) studied 55 electrics during the 1968-1972 period using the following model:

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coefficient over the five years of the study. Brigham and Gordon argued that since market/book ratios were about 2 to 2.5 over the period, the coefficient for the leverage variable measured in market value terms would be approximately 0.8.

[4]The coefficient values ranged from 0.4 to 0.7, and were statistically significant in only 5 of the 11 years. The values of the market value debt-to-equity ratio ranged from 0.59 to 0.88.

Dividend yield = b_0 + b_1(Growth rate) + b_2(Book value preferred/market value common equity ratio) + b_3(Book value debt/market value common equity ratio) + e.

They found that k_s changed on average by about 1.01 percentage points for a unitary change in the preferred stock leverage variable, and by about 1.74 percentage points for a unitary change in the debt variable. Mehta et al. also reached these conclusions: (1) The effect of preferred stock leverage on common equity costs is the same as the effect of debt leverage, except for the tax deductibility of interest expense. (2) If the leverage variable is defined as preferred leverage plus debt leverage multiplied by (1 - Tax rate), then a unitary increase in this combined leverage variable increases common equity costs by about 1.25 percentage points. If the combined leverage variable is measured merely by preferred leverage plus debt leverage, the effect of a unitary change is a 0.75 percentage point change in equity costs.

Finally, Patterson (1984) used a quadratic relationship between the cost of common equity and leverage, based on an assumed quadratic function for the value/leverage relationship. While his study, which used a sample of 114 utilities for the years 1975 to 1979, focused on the relationship between financial leverage and the value of the firm, he did conclude that the relationship between leverage (as measured by the market value debt/equity ratio) and the cost of common equity is a nonlinear function whose slope rises as leverage increases. However, he did not attempt to attach numerical significance to the relationship.

Summary

The empirical work is consistent with the hypothesis that k_s increases with leverage. However, the magnitude of the effect varies considerably both from year to year and between studies. Further, it is impossible to state that one of the studies is "more correct" than any other. Therefore, we decided to perform our own empirical study, which is described in Appendix D.

APPENDIX D
THE PURC REGRESSION STUDY

As we noted in Appendix C, prior empirical studies have yielded inconsistent results. Further, most of the studies are quite old, and they are based on data during a time when both business risks and capital costs were different than they are today. For both these reasons, we decided that a new empirical study was in order. Louis C. Gapenski undertook that study as his Ph.D. dissertation at Florida, and this appendix summarizes the relevant parts of his work.

A firm's cost of equity can be expressed as follows:

$$k_s = a_0 + \sum_{i=1}^{n} a_i F_i + \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} a_{ij} F_i F_j. \qquad (1)$$

Here

k_s = cost of common equity,

a_0 = intercept term,

F_i = n risk factors,

F_{ij} = interaction and second order terms, and

a_i and a_{ij} = regression coefficients, or factor weights.

Similar equations were set up to analyze the costs of debt and preferred stock.

Electric Utility Risk Factors

In addition to financial leverage, seven factors are often cited by security analysts as having an influence on an electric utility's cost of capital: (1) its regulatory environment, (2) its electric/gas sales mix, (3) its fuel mix, (4) the size of its construction program in relation to operating assets, (5) its nuclear construction program, (6) its reserve margin situation, and (7) its dividend policy. More factors could, of course, be added to the list, but a review of prior studies, the general literature, and utility analysts' reports suggests that the ones listed are the most important.[1]

Regulatory Environment

Regulatory agencies have an important influence over both the level and the riskiness of firms' earnings.[2] First, regulators influence the level of earnings by setting allowed rates of return and authorized rate bases. Second, regulators influence the riskiness of the earnings by affecting the allocation of risk between investors and ratepayers. Finally, inconsistent,

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[1] There should perhaps also be variables which measure a company's costs relative to other companies in its region on the grounds that a high-cost company is more exposed to load loss from cogeneration and/or industrial plant relocations, and also a variable that measures a company's operating efficiency on the grounds that operating inefficiencies will lead to high costs, hence to possible load loss and/or regulatory penalties. However, neither we nor anyone else has, thus far, been able to develop quantitative measures for these variables, and hence they are not included in the regression models. To the extent that they (1) are important and (2) are not already captured in the included variables, their omission will result in larger error terms and lower R^2 values. However, their omission will not affect the leverage variable's coefficient unless cost and efficiency, on a company-by-company basis, are correlated with leverage.

[2] The term "regulatory environment" encompasses public service commission actions, legislative actions, and court ations. We use the terms "regulators" and "regulatory agencies" to include all of these bodies, not just commissions.

arbitrary, uncertain, or "unfair" regulatory actions can affect a firm's riskiness.

Over 20 securities firms now review past and potential future actions of regulatory bodies and then rank utility companies' regulatory climate on the basis of regulators' impacts on the level, quality, and variability of earnings. Several recent studies have been conducted to determine the effect of regulatory rankings on capital costs. For example, Trout (1979), Archer (1981), and Dubin and Navarro (1983) all concluded that lower regulatory rankings increase capital costs, as did Fanara and Gorman (1986), who also found that the effect was considerably stronger in the early 1970s than in 1980.

<u>Gas/Electric Sales Mix</u>

Many utilities (the combination companies) provide both gas and electric services, and there is some evidence which suggests that gas operations might be riskier than electric operations. For example, Joskow (1972) found that the New York State Public Service Commission typically allowed a higher rate of return on equity for gas operations than for electric operations, presumably to account for greater risk. On the other hand, Dubin and Navarro (1983) concluded that there is no risk differential between gas and electric operations. Further, Brigham, Vinson, and Shome (1983) and Brigham, Tapley, and Aberwald (1984) presented some empirical evidence which indicated (1) that gas operations were (in 1983) slightly riskier than electric operations, (2) that the differential riskiness of gas versus electric varies over time depending on the price of gas relative to fuel oil and on perceptions of the long-run availability of gas supplies, and (3) that differences across companies also depend on the load mix of gas customers (residential versus industrial) and the company's situation on the electric side, especially its nuclear construction status.

Fuel Mix

Little work has been done which attempts to relate the mix of fuels it uses to generate electricity to a utility's risk. However, a firm's fuel mix affects (1) its operating leverage, (2) its input price uncertainty, (3) its risk of accidents or other operating problems, and (4) its environmental impact risk. Thus, there is a basis for postulating that the five basic types of generation--nuclear, coal, oil, gas, and hydro--have different inherent riskiness.

However, the inherent contribution of fuel mix to business risk may not be stable over time--for example, oil, coal, and nuclear fuels have all been "popular" with investors at certain times and "unpopular" at other times. Further, all the risks associated with fuel mix are not necessarily borne by the security holders, and hence they do not necessarily affect security costs. Specifically, some or all of this risk can be allocated by regulatory agencies to ratepayers through fuel adjustment clauses or other risk transfer mechanisms. However, different commissions utilize different procedures, and hence allocate fuel mix risk differently. All of this complicates and perhaps obscures the relationship between fuel mix and the riskiness of the utility's securities.

Construction Program

Risks associated with new construction programs could affect investors' required rates of return. First, after a period of inflation new plant is generally more costly than old plant. When a new plant is completed, it must go into the rate base if costs are to be recovered and a return is to be earned on the company's investment. If there is a delay in getting the new plant into the rate base, then the earned rate of return will suffer, and if any part of the costs are disallowed, then investors will incur a permanent loss. Further, because new plant typically has a much higher cost per unit of capacity than old plant (due both to inflation and to increasing environmental costs), "rate shock" may occur when new plant is added to the rate base. The greater the rate shock, the higher the probability of delays in getting new plant into the rate base, the higher the probability of load loss among industrial customers, and the higher the probability of disallowances and/or phase-in plans which delay cash flows. Also, large construction programs require massive new financing, and if new stock must be issued at less than book value, the current stockholders' positions will be diluted. Finally, there is always the risk that a plant under construction will be canceled and that stockholders will have to bear some or all of the costs incurred to date.

Nuclear Construction Program

The impact of nuclear construction programs on security risk is similar to but generally more severe than that of nonnuclear programs. Nuclear plants under construction carry more risk than conventional plants for at least four reasons: (1) the cost of nuclear plant has escalated more rapidly than conventional plant in recent years, (2) rate shock is generally greater when new nuclear plants go into the rate base, (3) completion times are more uncertain for nuclear plants, and (4) there is a higher probability that unfinished nuclear plants will be canceled and their costs written off. All of these factors have been compounded recently by uncertainty over the accounting treatment of costs whose recovery is uncertain or subject to long delays.

Reserve Margin

A high reserve margin tends to reduce the need for new construction, and in this sense it might be considered positive from an investor's viewpoint. Also, a high reserve margin reduces the risk of outages or hookup delays, both of which can lead to consumer complaints, to resistance to rate increases, and to a loss of regulatory goodwill. Conversely, a high reserve margin could indicate excess capacity, higher-than-necessary costs, and the possibility of load loss and/or regulatory penalties. A high reserve margin is especially troublesome for a company with a large construction program, for many of the problems associated with construction are exacerbated if new plant is not really needed.

Note, though, that it is often difficult to interpret reserve margins, and they are not necessarily similar across companies. For example, a reserve margin of 60 percent might not be bad at all if most of the off-line plant consists of old, inefficient, high-operating-cost equipment which has been largely depreciated, while a 40 percent margin could be quite bad if the excess plant has a high cost and is no less efficient than the plant that is being used to generate power.

Dividend Policy

One of the most debated issues in finance is whether a firm's dividend policy affects its cost of equity. Miller and Modigliani (1961) argued that in a world without personal taxes the cost of common equity would be unaffected by dividend policy. Conversely, Gordon (1959) took the position that dividends are cash in the hand while capital gains are uncertain future cash flows in the bush, and hence that investors require a higher return on low dividend payout stocks to account for their increased riskiness. However, this position has been disputed by Brennan (1971) and others. In addition, Farrar and Selwyn (1967) and Brennan (1970) argued that differential tax rates on dividends and capital gains results in investors requiring a higher rate of return on high payout stocks. Thus, three major, but conflicting, theories regarding the relationship between dividend policy and equity costs have been set forth in the finance literature.

The empirical evidence on this issue is as contradictory as the theories. Black and Scholes (1974) presented evidence which supports MM's dividend irrelevance hypothesis, but Litzenberger and Ramaswamy (1979) found a positive relationship between dividend yield and required rate of return which supports Farrar and Selwyn, and Brennan. With no theoretical or empirical consensus, it is difficult to postulate what effect, if any, dividend policy might have on the cost of equity to electric utilities.[3]

Methodology

We used Equation 1 as a multiple regression model to analyze the effects of financial leverage on debt and equity costs. The following sections describe the way the variables discussed in the preceding section were measured for use in the regression analysis.

Component Cost Measures

Equity. We measured the cost of equity in two ways, by a direct DCF estimate and indirectly by an analysis of market/book (M/B) ratios. In the direct DCF model,

$$k_s = \frac{D_1}{P_0} + g,$$

the dividend yield was found by dividing D_1, next year's expected dividend reported by Value Line, by P_0, the end-of-year stock price. The growth rate, g, is the 5-year median expected growth rate in earnings reported by Institutional Brokers Estimate System (IBES). The second method recognizes that M/B ratios are functionally related to equity capital costs, and hence that the

[3]The tax bill now (June 1986) being debated in Congress may have an additional effect on the dividend situation. If the Senate bill passes intact, it will essentially equalize the tax rate on dividends and capital gains. This would increase the attractiveness of dividends vis-a-vis capital gains. Gains will still have an advantage though, because they can be deferred by continuing to hold the stock.

M/B ratio can serve as a proxy for the cost of equity. The DCF k_s, although a direct measure of equity costs, probably has significant measurement error. Conversely, the M/B ratio has less measurement error, but as a proxy for k_s it may introduce specification error.

Debt. We also used two measures for the cost of debt, k_d. First, we used the S&P bond rating as the dependent variable and thus as a proxy for k_d. S&P translates its letter ratings into a numerical rating system with 2 = AAA, 4 = AA+, 5 = AA, 6 = AA-, 7 = A+, and so on (there is no number 1 or 3), and our approach recognizes that a direct relationship exists between a company's bond rating and its cost of new debt. In our second method, we converted the reported bond ratings to their matching S&P yields. However, since S&P only reports yields on the primary rating groups, that is, on the group without modifiers, all bonds rated AA+, AA, and AA- were assigned the yield reported for AA bonds, and so on. The first method, which uses bond ratings as a proxy for k_d, provides more detailed information, but (1) its regression coefficients measure the impact on rating rather than on k_d and (2) it assumes that at the analysis date the yield differentials between each rating category are equal (for example, that the yield differential between AA and AA- is equal to that between A- and BBB+), a condition that may not hold.

Risk Factor Measures

Regulatory environment. Regulatory environment was measured by the Salomon Brothers' rating of each utility's regulatory climate. These ratings, which can range from A+ to E-, where A+

is the most favorable climate and E- is the least favorable, were converted into a numerical scale as follows:[4]

Ranking	REGRANK
A+ to A-	1
B+ to B-	2
C+ to C-	3
D+ to D-	4
E+ to E-	5

Leverage. Five different measures of leverage were used: (1) BVDE is the book value debt-to-equity ratio, where equity is common equity only; (2) BVDPE is the book value debt-plus-preferred-to-common-equity ratio; (3) MVDE is the market value debt-to-common-equity ratio; (4) MVDPE is the market value debt-plus-preferred-to-common-equity ratio; and (5) EBVDPE is the expected future book value debt-plus-preferred-to-common-equity ratio as estimated by Value Line.[5]

Gas/electric sales mix. PCTGASREV is gas revenues as a percentage of total gas plus electric revenues.

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[4]Various combinations of dummy variables were also used to specify regulatory environment. The results were similar, so the dummy variable specification was dropped.

[5]Value Line estimates the average common equity ratio during a future three-year period. For example, in 1986, it reports the expected average equity ratio during the years 1988-1990. Thus, for all intents and purposes, the Value Line forecast represents the equity ratio expected three years into the future. Also, the market value of a firm's securities was estimated as follows: (1) Book value was used for short-term debt. (2) The market value of long-term debt was estimated based on embedded interest payments and the yield required on similarly rated bonds, assuming an average maturity of 20 years. (3) Book value was used for preferred stock. (4) The common stock's market value was based on the end-of-year stock price times the number of shares outstanding.

Fuel mix. Only these variables were used to measure fuel mix: PCTNUC, the percentage of nuclear generating capacity to total capacity; PCTCOAL, the percentage of coal generating capacity to total capacity; and PCTOIL, the percentage of oil generating capacity to total capacity.

Construction program. PCTCONST is Salomon Brothers' forecast of the percentage of total construction expenditures forecasted for the next three years to total current gross plant.

Nuclear construction program. NUCCONST is the company's total dollar investment in nuclear plants under construction expressed as a percentage of current gross plant. This variable was also obtained from Salomon Brothers, and the amount of investment includes both costs incurred to date and estimated completion costs.

Reserve margin. RESMAR is the percentage of unused generating capacity to total peak requirement based on the higher of summer and winter peaks. It was developed from S&P data.

Payout ratio. PAYOUT is Value Line's forecasted percentage payout ratio for the current year.

Data Sample

The data set consists of those electric utilities that are followed by Value Line, Salomon Brothers, and Standard & Poor's. However, we excluded companies which have lowered or omitted their common dividends on the grounds that those firms clearly violate the constant growth assumption. We had available two years of cross-sectional data, 1983 and 1984.[6] After applying data restrictions, the sample consisted of 70 companies for 1983 and 66 for 1984.

Statistical Procedures

We used two measures of the cost of equity with three measures of leverage, which result in 3 X 2 = 6 potential regression equations. Further, we used two measures of debt cost coupled with three measures of leverage for another six regression equations. Here is a summary:

Cost of Equity Models:

$$\begin{array}{l} \text{DCF } k_s \text{ or} \\ \text{B/M Ratio} \end{array} = \text{INTERCEPT} + \text{REGRANK} + \begin{array}{l} \text{BVDPE or} \\ \text{MVDPE or} \\ \text{EBVDPE} \end{array} + \text{PCTGASREV} + \text{PCTNUC}$$

$$+ \text{PCTCOAL} + \text{PCTOIL} + \text{PCTCONST} + \text{NUCCONST} + \text{RESMAR} + \text{PAYOUT}.$$

Note that rather than use the ratio of market price to book value for the M/B ratio, we used that ratio's reciprocal, the B/M ratio. This was done to facilitate an interpretation of the coefficients. For example, we expect companies with higher leverage to have higher equity costs, other things held constant, so the regression coefficient between k_s and leverage should be positive. However, we expect leverage to be inversely correlated with the M/B ratio--the higher the company's leverage, the lower its M/B ratio. To make the signs of the leverage variable consistent in the k_s and M/B models, we simply inverted the M/B ratio and used B/M.

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[6]The limiting data element is dollar value of incomplete nuclear plant, which was first reported by Salomon Brothers in usable form in 1983.

Cost of Debt Models:

$$\begin{array}{l} \text{S\&P } k_d \text{ or} \\ \text{Bond Rating} \end{array} = \text{INTERCEPT} + \text{REGRANK} + \begin{array}{l} \text{BVDE or} \\ \text{MVDE or} \\ \text{EBVDPE} \end{array} + \text{PCTGASREV} + \text{PCTNUC}$$

$$+ \text{PCTCOAL} + \text{PCTOIL} + \text{PCTCONST} + \text{NUCCONST} + \text{RESMAR} + \text{PAYOUT}.$$

Since we analyzed data over two years, and since we have six debt and six equity cost models for each year, a total of 24 regression runs were made. The SAS software package was used for the regressions, and procedures were automatically used to correct for heteroscedasticity, even though early tests did not indicate that the error terms would exhibit nonconstant variance.

A Priori Expectations about Coefficient Signs

Table D-1 contains the a priori estimates of the coefficients' signs based on the previous empirical and theoretical studies discussed earlier. Regulatory environment, both regular and nuclear construction, and all of the leverage variables should have positive coefficients, indicating that an increase in the variable's value raises k_s and k_d. However, there are no strong logical arguments to what the signs should be for the sales mix, fuel mix, reserve margin, or payout ratio variables.

Table D-1
A Priori Coefficient Estimates

Factor	Measure	Estimated Coefficient Sign
Regulatory environment	REGRANK (1 = best, 5 = worst)	+
Gas/electric sales mix	PCTGASREV	?
Fuel mix	PCTNUC	?
	PCTCOAL	?
	PCTOIL	?
Construction program	PCTCONST	+
Nuclear construction program	NUCCONST	+
Reserve margin	RESMAR	?
Financial leverage	BVDE	+
	BVDPE	+
	MVDE	+
	MVDPE	+
	EBVDPE	+
Dividend policy	PAYOUT	?

Summary of the Input Data

Table D-2 contains a summary of the input data. For the most part, the table is self-explanatory, but two points deserve clarification. First, the S&P bond ratings range from 4 = AA+ to 12 = BBB-, and the means for 1983 and 1984 indicate that the average company has an A rating. Second, the reserve margin, RESMAR, is negative for some utilities because they purchase a significant amount of the power they sell from other utilities. Note too that the means reflect unweighted rather than weighted averages.

Table D-2
Input Data Summary

Variable	1983 Minimum Value	1983 Maximum Value	1983 Mean	1984 Minimum Value	1984 Maximum Value	1984 Mean
k_s	12.8%	19.0%	15.8%	12.9%	17.3%	14.8%
B/M Ratio	0.61	1.35	1.04	0.60	1.44	0.98
k_d	12.6%	13.6%	13.0%	12.1%	12.9%	12.5%
Bond Rating	5	12	7.9	4	12	7.5
REGRANK	2	4	2.8	2	5	2.8
BVDE	0.68	1.86	1.27	0.62	1.83	1.22
BVDPE	0.86	2.11	1.54	0.78	2.15	1.48
MVDE	0.44	1.91	0.96	0.36	2.02	0.94
MVDPE	0.60	2.26	1.25	0.45	2.33	1.18
EBVDPE	0.77	1.70	1.29	0.83	1.94	1.24
PCTGASREV	0.0%	53.9%	13.7%	0.0%	66.2%	13.4%
PCTNUC	0.0%	83.0%	13.3%	0.0%	68.6%	13.6%
PCTCOAL	0.0%	100.0%	65.4%	0.0%	100.0%	63.6%
PCTOIL	0.0%	100.0%	9.1%	0.0%	100.0%	7.9%
PCTCONST	9.0%	175.0%	36.5%	10.0%	161.0%	33.5%
NUCCONST	0.0%	99.8%	17.9%	0.0%	94.8%	14.6%
RESMAR	-68.0%	54.5%	18.3%	-51.5%	56.2%	18.8%
PAYOUT	57.7%	94.7%	73.3%	52.9%	94.6%	72.0%

Correlation between Dependent Variables

Both logic and prior studies suggest that the cost of debt and the cost of equity for companies should be positively correlated, and we expected our two measures of debt and equity costs to be correlated with one another. Table D-3, which shows the correlation coefficients between the dependent variables, confirms that these conditions do hold. Three major points should be noted: (1) A look across the top row of Table D-3 will show that the correlations between the DCF k and the other dependent variables were stronger in 1983 than in 1984. Correlations among the other variables were not materially stronger in one year than the other. This could mean that the

DCF k variables in 1984 contain larger measurement errors than in 1983, but we really cannot explain why the differences occur. (2) As expected, there is generally a high correlation between equity cost and debt cost, regardless of the measures used. (3) As we also expected, there are extremely high correlations between the two cost of debt measures, Bond Rating and S&P k_d. These data suggest that one measure of debt cost is as good as the other, hence that it is not absolutely necessary to include both measures in the regression runs. However, the two equity cost measures are sufficiently different to warrant regression runs with each.

Table D-3
Dependent Variable Correlation Coefficients

	DCF k	B/M Ratio	S&P k_d	Bond Rating
DCF k	1.00/1.00	0.74/0.58	0.59/0.47	0.64/0.49
B/M Ratio		1.00/1.00	0.58/0.61	0.63/0.69
S&P k_d			1.00/1.00	0.94/0.95
Bond Rating				1.00/1.00

Note: The correlation coefficients for 1983 appear before the slash (/) and the coefficients for 1984 after it.

Multicollinearity

Multicollinearity can cause serious problems in multiple regression analyses, so at an early stage we examined correlations among the independent variables. These data are shown in Table D-4. To save space, only one leverage variable is listed, EBVDPE, because all the leverage variables are extremely highly correlated. Similarly, all the correlations with the fuel mix variables were low, and hence they too are omitted. For the remaining variables, only the correlation between PCTCONST and NUCCONST is high enough to cause concern, and, since neither of those variables is highly correlated with leverage, that collinearity is not a problem for our studies.[7]

Table D-4
Independent Variable Correlation Coefficients

	REGRANK	EBVDPE	PCTGASREV	PCTCONST	NUCCONST	RESMAR	PAYOUT
REGRANK	1.00/1.00	0.34/0.29	-0.01/0.08	-0.10/-0.14	0.04/0.03	-0.06/0.05	0.24/0.31
EBVDPE		1.00/1.00	-0.34/-0.19	0.23/0.29	0.41/0.29	-0.07/-0.27	0.21/0.25
PCTGASREV			1.00/1.00	-0.14/-0.22	-0.22/-0.21	-0.07/0.21	0.00/0.01
PCTCONST				1.00/1.00	0.71/0.81	-0.07/-0.04	-0.27/-0.23
NUCCONST					1.00/1.00	0.09/0.07	-0.02/0.02
RESMAR						1.00/1.00	-0.07/0.05
PAYOUT							1.00/1.00

Note: The correlation coefficients for 1983 appear before the slash (/), the coefficients for 1984 after.

Cost of Equity Results

Tables D-5 and D-6 contain summaries of the results of the equity and debt regressions. The reported R^2 values in Table D-5 are the adjusted R^2 for the runs which use MVDPE as the leverage measure. Note that the R^2 values are quite a bit higher when B/M is used as the dependent variable. However, there is probably spurious correlation between MVDPE, and that probably explains the higher R^2 values for the B/M models.

[7]We actually ran several other types of statistical analyses designed to test for the effects of multicollinearity. They all indicated that multicollinearity simply does not present a problem.

In general, the regression results are about what one would expect, based on an analysis of past studies. The R^2 values are in line with, but somewhat higher than, those reported in most past studies. The t-statistics are as high or higher than in most earlier studies. The leverage variables are generally statistically significant, especially those in the debt cost models.

Table D-5
Equity Regression Results:
Coefficients and t-Statistics of the
Statistically Significant Variables

	1983				1984			
Basic Risk	DCF k		B/M Ratio		DCF k		B/M Ratio	
Factor	Coef.	t	Coef.	t	Coef.	t	Coef.	t
INTERCEPT	12.1	(8.95)	0.63	(4.82)	13.8	(11.86)	0.61	(5.16)
EBVDPE	1.29	(1.94)	0.14	(1.80)	1.53	(2.41)	0.20	(2.59)
BVDPE	0.86	(1.67)	0.07	(1.16)	1.07	(2.33)	0.12	(2.04)
MVDPE	1.52	(3.79)	0.25	(6.35)	1.30	(3.28)	0.26	(6.48)
NUCCONST	0.02	(2.43)	0.002	(2.94)	0.01	(1.04)	0.002	(1.97)
RESMAR	-0.01	(2.05)	-0.002	(2.85)	-0.01	(2.26)	-0.0008	(1.25)
PCTGASREV	0.005	(0.71)	0.001	(1.78)	0.008	(1.21)	0.002	(3.04)
PCTNUC	-0.005	(0.74)	0.002	(2.52)	0.002	(0.33)	0.001	(1.02)
R^2	0.58		0.71		0.45		0.69	

Note: The critical values of t for 60 degrees of freedom are as follows:

Significance Level	Two-Tailed	One-Tailed
5%	2.00	1.67
1	2.66	2.39

Table D-6
Debt Regression Results:
Coefficients and t-Statistics of the
Statistically Significant Variables

Basic Risk Factor	1983 Bond Yield Coef.	t	1983 Bond Rating Coef.	t	1984 Bond Yield Coef.	t	1984 Bond Rating Coef.	t
INTERCEPT	11.6	(24.0)	-3.76	(1.54)	11.2	(38.3)	-3.94	(2.01)
REGRANK	0.04	(0.53)	0.43	(1.26)	0.09	(2.13)	1.03	(3.53)
BVDE	0.83	(4.65)	4.94	(5.45)	0.55	(4.99)	3.94	(4.80)
EBVDPE	0.76	(3.54)	3.71	(3.23)	0.54	(3.42)	4.27	(4.12)
MVDE	0.84	(5.34)	4.51	(5.45)	0.51	(4.51)	4.06	(5.53)
NUCCONST	0.008	(3.39)	0.06	(4.76)	0.007	(2.97)	0.06	(3.46)
RESMAR	-0.006	(2.95)	-0.03	(3.52)	-0.005	(3.51)	-0.04	(3.58)
PAYOUT	0.002	(0.40)	0.05	(1.95)	0.004	(1.24)	0.05	(2.12)
R^2	0.50		0.65		0.62		0.70	

Note: The critical values of t for 60 degrees of freedom are as follows:

Significance Level	Two-Tailed	One-Tailed
5%	2.00	1.67
1	2.66	2.39

Table D-7 shows estimated financial risk premiums at various leverage ratios based on the 0.97 average coefficient for BVDPE in the DCF k runs, while Table D-8 contains the same risk premiums based on the average EBVDPE coefficient of 1.41. In each case, the book value debt-plus-preferred to common equity (BVDPE) ratio was converted to a book value debt to total capital ratio assuming that the capital structure contains 10 percent preferred stock. Changes in the expectational leverage measure, EBVDPE, have more impact on k_s than changes in current leverage. One might conclude from this that equity investors weigh expected capital structure more heavily than current capital structure in assessing equity risk, since current structure may not reflect the firm's target capital structure and likely average future financial risk.

Table D-7
Effects of BVDPE Ratio on Equity Costs

Book Value Debt to Total Assets (D/A) (1)	BVDPE Ratio (2)	Financial Risk Premium: Levered Firm over Unlevered Firm (3)
30%	0.67	0.65 percentage points
40	1.00	0.97
50	1.50	1.46
60	2.33	2.26

Notes:

1. Column 2 simply converts debt/assets ratios to (Debt + Preferred)/Common equity ratios, assuming that peferred is 10 percent of total capital. For example, if D/A = 30% and Preferred/Assets = 10% (which we assume), then E/A = 60% and (Debt + Preferred)/Equity = (30 + 10)/60 = 0.67 as shown at the top of Column 2. Other values in Column 2 were obtained similarly.

2. Note also that the average regression coefficient from Table D-5 for BVDPE over 1983 and 1984 was 0.97. This coefficient is multiplied by the value of BVDPE to obtain the effect of leverage on k_s. If BVDPE were zero, then there would be no leverage effect. If BVDPE were 0.67, then k_s would be increased over the zero debt level by 0.67 X 0.97 = 0.65 percentage points. That value is shown at the top of Column 3. Other values were obtained similarly.

3. Note that the financial risk premium increases <u>linearly</u> with BVDPE, but <u>nonlinearly</u> with D/A. Thus, a 10 percentage point increase in D/A from 30% to 40% produces a 32 basis point increase in k_s, but a 10 percentage point increase in D/A from 50% to 60% produces an 80 basis point increase in k_s.

Table D-8
Effects of EBVDPE Ratio on Equity Costs

Expected Book Value Debt to Total Assets (D/A) (1)	EBVDPE Ratio (2)	Financial Risk Premium: k_s over k_u (3)
30%	0.67	0.96
40	1.00	1.44
50	1.50	2.16
60	2.33	3.36

Note: See notes to Table D-7.

The leverage results can also be compared to previous studies. The average coefficient for BVDPE for the two years was 0.97. This means that a unitary increase in BVDPE is estimated to increase equity costs by 0.97 percentage points. Brigham and Gordon (1968) reported 0.33 percentage points, Gordon (1974) reported 0.5 percentage points, Robichek, Higgins, and Kinsman (1973) reported 0.9 percentage points, and Mehta et al. (1980) reported 0.75 percentage points. Of course, there are minor definitional differences among the studies, so the results are not entirely consistent. Also, capital costs have generally increased over the period of these studies, so one would expect our 1983 and 1984 coefficients to be larger because of the higher cost of capital in those years.

There is no indication that the relationship between equity costs and leverage, when measured by leverage-to-equity ratios, is nonlinear over the range of observation. Also, there is no consistent statistical evidence supporting interactions among the equity risk factors.

Effects of Leverage on the Cost of Debt

Table D-6 shows that the leverage coefficient is insensitive with regard to the particular leverage measure used--the coefficients in each of the two years were highly consistent. However, the impact of leverage on debt costs was greater in 1983 than in 1984. Table D-9 shows the estimated effects of financial leverage on debt costs based on the regression analysis. There is no strong evidence of interactions or second order terms in the debt models.

Table D-9
Effects of BVDE Ratio on Debt Costs

Book Value Debt to Total Assets	BVDE Ratio	Financial Risk Premium: Levered Firm over Unlevered Firm
30%	0.50	0.37
40	0.80	0.60
50	1.25	0.93
60	2.00	1.49

Use of Regression Results in the Lotus 1-2-3 Model

The Lotus 1-2-3 model which we use to analyze the effects of changes in capital structure on revenue requirements, customer bills, coverages, and the weighted average cost of capital requires as inputs the relationship between capital structure and the cost rates of debt and equity. Indeed, the primary purpose of our regression analysis was to develop inputs for the 1-2-3 model. Our thought was to use the data in Tables D-7, D-8, and D-9 to produce inputs for the 1-2-3 model. However, direct usage of the regression results would not be appropriate because of statistical problems associated with measurement errors in the independent variables.

Regression analysis is based on a number of assumptions, one of which is that all variables are measured without error. With some types of data, this assumption poses no problem--for example, in studies of the effects of rainfall on the output of wheat per acre, both rainfall and bushels per acre can be measured with little or no error. However, in cost of capital studies, where the variables reflect investors' expectations, measurement errors cannot be avoided. Thus, we might measure Company X's cost of equity as seen by the marginal investor at year-end 1984 to be 15 percent, but that 15 percent estimate almost certainly differs from the "true" but unobservable cost of equity. Similarly, in our regression analysis we want a leverage variable that reflects the average investor's expectations about the company's leverage condition over some future time horizon, yet we have no way of knowing for sure either the length of investors' time horizons or what they think the firm's capital structure will be over that horizon. Further, we do not know if investors in the market focus on market value capital structures as academicians generally assume or on book value structures as companies, regulators, rating agencies, and analysts seem to do. So, the only thing we can be absolutely sure of, when we measure leverage by year-end BVDE, MVDE, MVDPE, or BVDPE, or by Value Line's expected measure, EBVDPE, is that there is at least some difference between our estimate and that of investors at the margin. The same thing could be said about each of the other independent variables.

What are the effects of measurement errors? With regard to an independent variable, a measurement error causes a downward bias in the variable's regression coefficient, with the degree of bias depending on the degree of error. For example, the coefficient for the BVDPE leverage variable as determined in the equity regression analyses was 0.97, but if the values used in the regression for BVDPE differ randomly from company to company from what the average investor expects the future debt ratio to be, then the 0.97 coefficient will understate the true relationship, and the effects of leverage on k_s shown in Table D-7 will be similarly understated.

In Appendix E we present the bond rating guideline method for estimating the relationships between leverage and capital costs. This method gives a better estimate of the leverage/debt cost relationship than does our regression study, primarily because of the measurement error problem discussed above. We used the results of the bond rating guidelines method to estimate the impact of measurement error on the regression results, and found that the BVDPE coefficient is approximately 2.4 after correcting for measurement error. With this correction, an increase in the BVDPE ratio from 40 to 50 percent would increase the cost of equity by about 120 basis points. We believe that this estimate, which is adjusted for measurement error, is much closer to the true relationship than the 49 basis points indicated in Table D-7. The exact procedure used to estimate the adjustment for measurement error is discussed in Appendix E.

Summary

This appendix sets forth the results of our regression studies of the effects of leverage on the costs of both debt and equity. We used a linear multiple regression model, fitted with data on the electric utilities followed by Value Line, Salomon Brothers, and IBES. The cost of equity was estimated in two ways, one based on the constant growth DCF model and the other on the market/book ratio. Leverage was measured in both book value and market value terms, with preferred stock both included and excluded, and with the ratios based on both year-end and projected levels. The statistical results were slightly stronger when Value Line's projected capital structure data as opposed to current year data were used, indicating that investors give more weight to the projected capital structure than to its current level.

While our results were as good as or better than those of prior studies in terms of statistical significance, we still cannot place great confidence in those results with regard to specifying the effect of leverage on the cost of either debt or equity. Therefore, we decided to explore other approaches to estimating this effect, as we discuss in Appendix E.

APPENDIX E
USING BOND RATING GUIDELINES TO ESTIMATE THE EFFECTS OF LEVERAGE ON THE COST OF CAPITAL

If we have reason to believe that a given change in capital structure will have a specific effect on a company's bond rating, and if we can ascertain the effect of a rating change on the cost of debt or equity, then we can use this relationship to measure the effect of a change in capital structure on the cost of capital. For example, if an increase in the debt ratio from 42.5 percent to 48 percent would cause a utility's bonds to be downgraded from Aa to A, and if that downgrading would cause the company's bond yield to increase from 10.5 to 11.0 percent, then we could state that a one percentage point change in the debt ratio was associated with a (11.0 - 10.5)/(48.0 - 42.5) = 0.0909 percentage point change in the cost of debt. Such a procedure, applied to both debt and equity, is discussed in this appendix.

Bond Yield Spreads

To apply the method, we need to know the effect of a rating change on a company's bond yield, or cost of new debt, k_d. Table E-1 provides some information on that point. Note that yields to maturity on both seasoned bonds and new issues are reported in the table; the two sets of data are highly correlated, but substantial differences may be observed in certain years. For example, outstanding A-rated bonds were reported to yield 14.43 percent in 1982 versus 12.48 percent for new issues. Such differences are caused by a number of different factors, including differences in call features, different coupon rates (which have tax implications), different maturities, and the like. Also, relatively few new bonds of a given rating are issued in any one month, so the new issue data tend to reflect random variation caused by small sample size.

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Table E-1
Bond Yields, 1976-1985

	Yields on Outstanding Public Utility Bonds				Yields on New Issues of Public Utility Bonds			
	Aaa	Aa	A	Baa	Aaa	Aa	A	Baa
Dec 1985	10.24%	10.57%	10.97%	11.48%	n.a	10.62%	10.84%	11.65%
Dec 1984	12.49	12.76	13.11	13.46	n.a	12.45	12.48	13.13
Dec 1983	13.00	13.14	13.52	14.23	n.a	12.58	13.16	13.59
Dec 1982	12.32	12.76	14.43	14.69	11.70%	12.04	12.48	13.23
Dec 1981	14.52	15.23	16.29	17.02	15.91	15.85	16.01	18.14
Dec 1980	13.62	14.37	14.63	15.29	12.94	12.88	14.42	14.67
Dec 1979	10.96	11.47	11.79	12.51	10.93	12.00	12.49	13.08
Dec 1978	9.34	9.56	9.70	10.08	9.37	9.85	9.95	10.15
Dec 1977	8.34	8.55	8.64	9.08	8.27	8.40	8.56	9.15
Dec 1976	8.15	8.45	8.62	9.21	7.90	8.22	8.41	8.61
Average	11.30%	11.69%	12.17%	12.71%	11.00%	11.49%	11.88%	12.54%

Source: Yields on outstanding bonds were obtained from Moody's Bond Record, while yields on new issues were obtained from Moody's Bond Survey. December data were taken from January issues. In the case of new issues, there were occasions where no issues in a particular category occurred during December. In those instances, we used the month closest to December in which issues occurred in all rating categories.

Note: There were no new issues by Aaa utilities during the months we examined in 1983-1985. Therefore, the Aaa average does not reflect data from these three years.

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The 1982 differences are far greater than most, but a question still exists: For our purposes, which set of data would be better? To answer that question, we need to consider the data sets themselves, and the underlying causes of the differences. First, we determined that the yield index for outstanding bonds is based on 10 bonds with maturities averaging about 20 years. All of these bonds were issued in the past, and their coupon rates vary depending on interest rate levels at the time they were issued. Utility bonds generally have five years of call protection, so some of the outstanding bonds are probably callable, and the individual bonds could be selling above or below par, depending on their coupons, relative to market yields and remaining call protection. Perhaps the biggest problem with using yields on outstanding bonds as an indicator of k_d has to do with yield-to-maturity (which is reported) versus yield-to-call. For example, consider a 30-year, 15 percent coupon bond with a 27-year remaining maturity that is callable in 2 years at 112.5 which is being evaluated in a market where k_d is 10 percent. That bond will have a yield to maturity (semiannual basis) of 12.5 percent, but a yield to call of only 10 percent, and the YTC is the yield that knowledgeable investors will expect on the bond. The YTC is thus the best indicator of k_d, even though the bond index would include it at the 12.5 percent YTM. Therefore, one must be suspicious of bond index yields as representations of k_d during periods when interest rates have been declining.

The preceding discussions suggest that it would be better for present purposes to focus on new issues, for the index of new issue yields avoids the YTM versus YTC problem. However, the new issue yield index has a major problem of its own--randomness caused by small sample sizes. In many months, either no bonds of a given rating or only one or two bonds of that rating were issued. If interest rates fluctuated during the month, and one bond of an A1 company was issued at the low point during the month, the new issue yield for that month will be relatively low. If the bond happened to have a 7-year maturity, and if the yield curve is upward sloping, the bond's yield will be lower yet vis-a-vis the k_d we are seeking. This type of thing makes us worry about using the new issue yield index for our purposes.

Yet another problem has to do with the time period analyzed. A quick look at Table E-1 will show that yield spreads, hence the effects of a change in ratings on capital costs, are materially different in different periods.

Finally, there is the matter of which rating agency's index to use, Moody's or S&P's. As noted in the next section, we use the S&P rating guidelines, so consistency would suggest that we should use the S&P index yields. However, based on past work with the two indexes, we are somewhat more comfortable with Moody's data.

In the end, we decided to use both outstanding bonds and new issues over a 10-year period and to base the analysis on Moody's data. We obtained the following averages:

	Aaa		Aa		A		Baa
Yields	11.15%		11.59%		12.02%		12.62%
Differences		0.44%		0.43%		0.60%	

Thus, a reduction of one full rating leads to an increase in the cost of new debt of about 50 basis points, on average, and a reduction from Aaa to Baa would lead to an increase of about 150 basis points. Since these figures reflect the yield to investors, not the cost to a company, and since flotation costs tend to be somewhat lower for higher rated securities, the differences would probably be a little larger on a cost-to-company basis.

Standard and Poor's Guidelines for Telephones

S&P provides explicit guidelines for the leverage ratios associated with its bond ratings; those guidelines for the telephone industry are contained in the top part of Figure E-1. The benchmark for a AAA rating is 35 percent or less; for AA the benchmark is 35 to 40 percent; it is 40 to 50 percent debt for an A rating; it is 50 to 60 percent for BBB; and the guidelines indicate that a company with a debt ratio above 60 percent should be rated Ba.[1]

The middle part of Figure E-1 shows the midpoint debt ratio for each rating category, along with the average bond yields discussed earlier in the appendix. Next, we show the leverage differences and yield differences between the rating midpoints. For example, the average yield differential between AA and A rated telephone bonds is 12.02% - 11.59% = 0.43 percentage points

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[1]S&P notes, in its discussion of guidelines, that a strong (or weak) leverage ratio could be offset by some other factor such as coverage. Also, S&P is very much interested in trends, so a company with a debt ratio of 42 percent, but with a target of 40 percent and downward trend which indicates that it is moving toward the target, might be rated on the basis of the 40 percent target ratio rather than the 42 percent actual figure. Thus, companies' actual ratings will not necessarily be consistent with the published guidelines.

= 43 basis points, while the leverage differential is 45% - 37.5% = 7.5 percentage points.

The bottom line of Figure E-1 shows the percentage point impact on the cost of debt, k_d, resulting from a one percentage point change in the debt ratio. In the 37.5 to 45 percent debt ratio range, a 7.5 percentage point increase in debt usage would result in a 43 basis point increase in debt cost, and this works out to a 5.7 basis point increase in debt cost per percentage point increase in debt. Similarly, an increase in leverage of one percentage point raises debt cost by 6.0 basis points when the change falls within a debt range of 45 to 55 percent.

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Figure E-1
S&P Leverage Guidelines for Telephones

Bond Rating	AAA		AA		A		BBB		BB
Debt to Total Capital		35%		40%		50%		60%	
Midpoint of Range			37.5%		45%		55%		
Average Yield for Rating			11.59%		12.02%		12.62%		
Leverage Spread				7.50		10.00			
Yield Spread				0.43		0.60			
Change in k_d per Percentage Point Change in Leverage				0.057		0.060			

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Standard and Poor's Guidelines for Electrics

Figure E-2 is identical to Figure E-1 except that it is based on the S&P guidelines for electric utility bond ratings.

For electric utilities, a percentage point increase in debt usage results in either a 0.078 or 0.100 percentage point increase in debt costs, depending on the leverage range in which the move is made.

Figure E-2
S&P Leverage Guidelines for Electrics

Bond Rating	AAA		AA		A		BBB		BB
Debt to Total Capital		40%		45%		51%		57%	
Midpoint of Range			42.5%		48%		54%		
Average Yield for Rating			11.59%		12.02%		12.62%		
Leverage Spread				5.50		6.00			
Yield Spread				0.43		0.60			
Change in k_d per Percentage Point Leverage Change				0.078		0.100			

Effects on the Cost of Equity

One frequently-used procedure for estimating the cost of common equity is the bond-yield-plus-risk-premium method.[2] When this method is used, it is assumed that the same factors that affect the riskiness and consequently the cost of debt also have a similar effect on the riskiness and the cost of equity. However, there is no reason to think that a change in leverage

[2]Brigham and Gapenski, Intermediate Financial Management, pp. 144-145.

would have the same effect on the cost of equity as on the cost of debt; indeed, the effects of leverage changes are likely to be far greater on the cost of equity than on the cost of debt. This point was discussed in Appendix B, where we noted that the original capital structure theories were based on the assumption that capital structure changes had a major effect on equity's cost but no effect whatever on the cost of debt. The logic here had to do with the fact that debt has a fixed claim on income and assets, whereas equity is a residual security. Subsequent theoretical work modified that assumption, but all the theoretical work suggests that the effect of leverage on debt is far less than on equity.

The theoretical arguments are also supported by our regression studies. The coefficient of the leverage variable in the equity cost models was generally about 1.5 to 2 times the size of the coefficient in the debt models. Since the coefficients reflect the effect of a change in capital structure on the costs of debt and equity, the relative size of the coefficients suggest that capital structure has considerably more impact on equity costs than on debt costs. Note that Table D-9 in Appendix D shows that on the basis of our regression study, an increase in leverage from 40 to 50 percent debt results in an increase in debt cost of 33 basis points. However, Figure E-2, based on bond rating guidelines, indicates an 82 percentage point increase in debt costs. Thus, the bond rating guidelines estimate is $82/33 \simeq 2.5$ times greater than the regression estimate. We attribute this difference to measurement error (see

Appendix D), and we believe that the estimated equity relationship developed from the regression study is also downward biased. If we assume that the amount of bias is the same for the debt and equity relationships, then we can adjust the regression equity results by the same 2.5 multiplier. Table D-7 indicates that equity costs would increase by 49 basis points when the debt ratio is increased from 40 to 50 percent. After adjusting for measurement error we estimate the increase in equity cost to be 2.5(49) $\simeq$ 120 basis points.

Summary

The results of the various studies of the effects of leverage on the cost of equity are mixed. Obviously, we cannot make any precise statements from all this regarding the specific effects of a given change in capital structure on the cost of equity, but we can set forth some judgmental, ball-park figures which can be used to help specify ranges in our Lotus 1-2-3 model. Here are some figures:

	Debt Ratio Range	
	37.5% - 45%	45% - 55%
Telephone:		
Effect of a one percentage point change on k_d	5.7 b.p.	6.0 b.p.
Effect of a one percentage point change on k_s	9.0	11.0

	Debt Ratio Range	
	42.5% - 48%	48% - 54%
Electric:		
Effect of a one percentage point change on k_d	7.8 b.p.	10.0 b.p.
Effect of a one percentage point change on k_s	12.0	14.0

APPENDIX F
DESCRIPTION OF THE PURC CAPITAL STRUCTURE MODEL: ELECTRIC AND GAS COMPANIES

This appendix describes a Lotus 1-2-3 model which analyzes the effects of a change in capital structure on a utility's stock price and financial position.[1] Inputs, including capital structure and component cost rates, are entered, after which the model forecasts the utility's balance sheets and income statements over a 16-year period. (The model has a historic balance sheet for one year and pro forma balance sheets and income statements for 16 years.) The model also forecasts revenue requirements, market/book ratios, the weighted average cost of capital, customers' monthly bills, earnings and dividends per share, coverage ratios, and the estimated stock price for each forecasted year.

Required inputs include estimates of the cost of debt and equity under different capital structures. It should be recognized that no one can measure accurately the cost of equity at a given capital structure, much less tell precisely how equity costs will change if the capital structure is changed. In Appendices D and E we discuss our work on the relationship of the costs of equity and debt to capital structure. Still, judgments must be made on these issues, and one advantage of the Lotus 1-2-3 capital structure model described in this appendix is that

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[1]Appendix F is very similar to Appendix G, except G deals with telephone companies while F is written for electric and gas companies. Someone interested primarily in electric and gas companies should skip G and read F, while people with a primary interest in telephone companies should do the reverse.

one can analyze the effects of different assumptions about the capital structure/cost rate relationship, with the output showing the sensitivity of customers' bills, coverage ratios, and so on to different assumptions. Therefore, the model can give decision makers insights into the effects of alternative courses of action under a variety of assumptions.

Because the project's objective was to examine the different utility industries, including both energy and telecommunications companies, we developed a model that with minor changes can be modified for electric, gas, or telecommunications companies. The model modifications involve inserting terminology peculiar to the industry rather than major financial formula changes. For example, used with an electric company, the model would develop price per 1,000 kilowatt hours for each billing category: residential, industrial, commercial, and other. For a gas company, we would merely substitute MCF for KWH. However, for a telephone company the model would develop the monthly bill for residential customers and break it down into the basic bill and other charges. (The bill for other customers such as large business could be determined as well.) The energy model is discussed in this appendix, while the telecommunications model is discussed in Appendix G. For ease of understanding, it is best to read this appendix sitting in front of a PC with the model on the screen.

Layout of the Energy Model

The model is programmed in Lotus 1-2-3. Its layout is shown in Figure F-1, while Table F-1 shows the file's contents, provides instructions for its use, and gives the cell ranges of the various model sections.

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Table F-1
Contents of Energy Model and Directions for Its Use

I. The following sections are on this file:

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A74.R94	2	Balance Sheets, 1985-2001
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A227.R241	8	TIE Ratios under Various Model Runs

II. To position a section on the screen: Press function key F5, the "GoTo" key, then type the first cell shown in the range for the section, and then press the RETURN key.

III. The sections now have illustrative data. You can use the model with a specific company's data simply by entering new data in the highlighted cells in Section 1. When you enter data for a company, Sections 2 through 4 will be completed automatically. Note that all cells except the input data cells in Section 1 have been protected. The input cells which you may change are highlighted. If you need to modify the model formulas, you may disconnect the protect feature with this command: /WGPD. If you attempt to write in a protected cell, you will hear a beep and receive an error message. We recommend that you reprotect the worksheet after making your changes with the command /WGPE. You should not use the Range Erase command to erase the input cells in Section 1. If you do, and if you then press the F9 (CALC) key, zeroes and ERRs will appear throughout the worksheet. Due to the circularity of the model, once error terms appear some of the formulas cannot be recalculated even after the new data have been entered--it is then necessary to edit the individual formulas. Therefore, you should simply replace the existing input values with your own data rather than by deleting our data and then changing blank cells.

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Figure F-1
Capital Structure Model Diagram, Energy Model

MODEL SECTIONS	A1		R1
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	A194		R194
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	A241		R241

Basic Assumptions and Input

Certain basic assumptions are programmed into the model. You should be aware of them so that you will understand the model's limitations and also so that you can change our assumptions (by changing certain formulas) if you feel that they do not apply in the situation with which you are working. We combine our discussion of assumptions with a discussion of the input data section, Section 1. The cells in which data can be entered are unprotected and hence show up highlighted, while all other cells have been protected to prevent formulas from being accidentally changed or erased. The entries in this section form the basis for the projected 16-year balance sheets and income statements. Please note that the model presents a base-year balance sheet, forecasted balance sheets for 16 years, and forecasted income statements for 16 years.

1. Model years. We developed the model for a base year (1985) plus a 16-year forecast period (1986-2001). It would be easy to change the years to begin with a different base year.
2. Inflation and tax rate. Base year values for inflation and the tax rate are entered in B15.C16, and the model then copies them into the forecast years. However, if you wish to override the model and enter different values for different forecast years, this could easily be done by first unprotecting the model and then making the necessary changes. In our runs, we assumed a 5 percent inflation rate, and we use the current statutory tax rate of 46

percent. However, we also examined the impacts of the proposed tax law change to a 33 percent tax rate. (We discuss the effect of changes in the statutory rate in the Summary and Overview section of this report.) We do not deal explicitly with either the investment tax credit or depreciation rates.

3. Fixed and variable costs. The base year values for fixed and variable costs appear in Cells C17 and C18, while fixed and variable costs for the forecast period are in Section 3 of the model, in Range C120.R121. A review of several of the Florida utilities' annual reports indicated that variable and fixed costs were roughly equal. Therefore, we used a 50-50 split of costs between variable and fixed, and we also assumed that both fixed and variable costs increased with the asset growth rate, which reflects both inflation and output growth. It is implicitly assumed that construction costs increase by this same rate. Again, these assumptions could easily be changed by modifying the formulas in Range C120.R121.

4. Asset growth rate. We do not input separately an asset growth rate. Rather, we assume that all assets are used at the optimal operating rate, so the reserve margin will not be changed. Therefore, the asset growth rate is a function of both inflation and output growth:

$$\begin{matrix}\text{Asset}\\\text{growth rate}\end{matrix} = \text{Inflation} + \begin{matrix}\text{Unit}\\\text{growth}\end{matrix} + \begin{matrix}\text{Unit}\\\text{growth}\end{matrix} * (\text{Inflation})$$

5. Flotation costs. Many studies of equity flotation costs exist; generally, these studies indicate that such costs

total from 3.5 to 4 percent of the gross proceeds. There have also been studies of market pressure, and of the best way to handle the recovery of equity flotation costs plus pressure effects, but these issues are far more complex and controversial than flotation cost measurement.

In this model we have assumed that flotation costs plus pressure total 3.5 percent. We input a base year value for the percentage flotation cost of an equity issue, and the model then copies the base year value into the forecast period. A major assumption in this model concerns the treatment of equity flotation costs. We assume that in the future such equity flotation costs are consistently expensed, and are therefore built into revenue requirements on an as-incurred basis. On the other hand, and consistent with accepted practices nationwide, we assume that debt and preferred stock flotation costs are amortized and are incorporated into embedded and marginal cost rates.

Equity flotation costs are calculated in Section 3 of the model in cells C128.R128 as follows:

$$\text{Equity flotation cost} = \text{Flotation cost percentage} \times \text{Number of shares repurchased or issued} \times \text{Year-end stock price}$$

Flotation expenses are not tax deductible, so they are subtracted from earnings after taxes have been calculated. The equity flotation cost percentage may be changed in each year by modifying the model in the input section, Section 1. Major model modifications would be required to change the assumption of equity flotation costs being expensed. (The treatment of these costs in practice presents, in our view, a major error in regulatory accounting. Oftentimes, these costs seem to be neither expensed nor capitalized, and the result seems to be nonrecovery unless a company is permitted to earn more than its bare bones cost of capital and to sell at a price above book value. At one point, we attempted to model this treatment of equity flotation costs, but the model became so complex that it obscured the capital structure issue, so we abandoned the effort.)

6. Debt, preferred, and common equity costs. The debt and preferred stock outstanding at the beginning of the analysis has an "embedded" cost. These base year data are entered in cells C25 and C28, respectively. The embedded cost of debt is the average interest cost on the currently outstanding debt. The embedded cost of debt after the base year is calculated as interest paid each year divided by total debt outstanding. The embedded cost of preferred equity is calculated as preferred dividends paid divided by total preferred outstanding. To simplify things, we assume that all financing is done at year end. Therefore, to calculate the embedded cost rates for the year, the beginning of year debt and preferred equity (which in this model are obtained from the prior year's ending balance sheet) are used in the calculation.

New debt and preferred issues (marginal debt and preferred) normally have cost rates which differ from the embedded rates, and these marginal cost rates must be entered for individual years in Section 1 of the model in Ranges B24.R24 and B29.R29, respectively. Also, the cost of common equity capital must be entered in Section 1 of the model for each analysis year (B22.R22). Both the equity cost rate and the marginal costs of debt and preferred should, in general, be higher if more debt is used in the capital structure. However, as all finance textbooks indicate, and as all financial experts know, it is extremely difficult to specify the levels of these values. We discuss the basis for our inputs in Appendices C, D, and E.

One issue that arises is whether the marginal cost rates will jump to the new cost rates as soon as the new target capital structure is announced, or will change gradually, as the actual capital structure changes. We concluded that the cost rates would change abruptly if a weaker target capital structure were announced, even before the new target was achieved. Thus, if a company announced that it planned to increase its debt ratio from 50 to 60 percent, the cost rates on debt, preferred, and common would all rise immediately. We were less sure that the reverse would hold true--an announced plan to strengthen the capital structure might be greeted with skepticism, and investors might wait until the change had actually been made to lower the cost rates. Nevertheless, in our runs we assumed that capital costs would change immediately after any capital structure change announcement. In any event, the user is free to change our assumptions--the model permits any inputted marginal cost rates the user chooses to employ.

7. Earned return on equity. Under "perfect" regulation, the earned rate of return would exceed the cost of equity by 40 to 60 basis points to reflect an adjustment for flotation. In the real world, allowed and earned rates normally vary from that ideal range. Still, in most of our runs, we specify that the company earns a rate of return that is 40 to 60 basis points above the cost of equity, and thus we assume "ideal" regulatory conditions. It is, however, easy enough to specify all manner of regulatory conditions; equity cost rates and the earned rate of return on equity are entered as separate inputs, so a model user can force the company to earn whatever rate of return he or she chooses.

The most interesting, difficult, and controversial issue is the relationship between the cost of equity and the capital structure. Our studies, which are described in Appendices D and E, suggest that a 5 percentage point change in the debt ratio, from its current level of 48 percent, would cause a 50 basis point change in the cost of equity, and we used this specification in our most likely case runs. However, we also changed the specifications to show what would happen if equity costs were either more or less sensitive to capital structure changes, and the model makes it easy for someone to input a wide range of inputs. Again, though, please note that we are prepared to defend our base case values, and others must be prepared to defend theirs.

The earned return on equity is entered in cells C23.R23 and then used in Section 3 of the model for calculating the company's net income in the range C131.R131. In the long run, assuming equity flotation costs are expensed and thus recovered on an as-incurred basis, utilities should have an earned return on equity which equals their cost of equity. In the short run, significant departures from the long-run ideal can occur. For example, if equity flotation costs have not been expensed, then the allowed (and earned) equity return should exceed the bare bones cost of equity. Further, if a utility (or its holding company) has unregulated subsidiaries, they can earn more or less than the cost of capital. Finally, a commission can use incentive rates under which companies deemed to be operating especially efficiently can be allowed to earn a return somewhat above their equity capital cost, while inefficient companies can be penalized.

All of these factors could have a bearing on the way the model is programmed, and on its output. For example, we could specify an equity capital cost and then force the earned equity return to equal that cost. An alternative specification--which we adopted in our model runs--is to specify both an equity cost rate and an earned return on equity, and then to have the model maintain these relationships. Note, though, that it would be a trivial task to force the two rates to be equal--one would merely need to specify one set of rates (say the cost of equity) and then copy those rates into the input range for the other variable.

8. <u>Embedded costs of debt and preferred</u>. Base year embedded costs of debt and preferred equity are entered in C25 and C28 as previously discussed in Item 6. The starting points for the embedded costs of debt and preferred are 9 percent for debt and 8 percent for preferred. For years following the base year, the embedded debt and preferred cost rates depend jointly on the marginal debt and preferred costs and on the amount of debt and preferred raised each year. The embedded cost rates will normally be different from the costs of new debt or preferred issues. However, for our purposes we assumed that the embedded costs would equal marginal costs in the base year. Marginal debt and preferred costs are entered in Ranges B24.R24 and B29.R29, respectively. The base year values used for new debt and preferred--9 and 8 percent, respectively--approximate current new-issue rates. Marginal cost rates following the base year depend on capital structure changes. The relationship of debt costs to capital structure was developed from Standard & Poor's rating guidelines as discussed in Appendix E. We assumed that the marginal cost of preferred would change by the same amount as the cost of debt for a given capital structure change.

All debt is assumed to have a 30-year maturity, but this can be changed by modifying the formulas in Section 4 and in Cells C27.R27 of the input section. To change this assumption, one must change the number 30 wherever it appears in those areas and replace it with the alternative maturity value. A sinking fund provision built into the model requires that one-thirtieth of each vintage of debt be retired in each year. Note that the percentage of debt retired in each year depends on both the maturity of the debt and the amount of debt at that maturity. The amount of debt refunded each year is calculated as the sum of each debt vintage divided by its maturity. The refunded debt is then reissued at the current (marginal) cost of debt for that year. The debt refunding and total debt outstanding schedules are shown in Section 4 (A151.R179). All financing is assumed to be done at the end of the year. The model forces the capital raised to be consistent with the prescribed target capital structure as given in Section 1 of the model, B30.R32.

The embedded debt cost, the embedded preferred cost, and the cost of common equity are used, along with the amounts of each type of capital, to calculate the weighted average cost of capital in C139.R139, in Section 3 of the model.

9. Year currently outstanding debt redeemed. This value, shown in Range C27.R27, is a calculated value based on the current year's value plus the average maturity assumed for the debt. If the average debt maturity assumption were changed, this formula would have to be modified. In this model we assumed that all debt has a 30-year maturity, and the debt has a

sinking fund requirement which necessitates that one-thirtieth of each debt issue be retired each year.

10. Capital structure ratios. A review of the Florida utilities' capital structures indicates that an "average" structure consists of 48 percent debt, 10 percent preferred, and 42 percent equity, so these values were used for the base year. The values for the years that follow depend on whether we are examining a scenario where the target capital structure is changed to include more or less debt. For simplicity, the preferred ratio is assumed to remain constant at the 10 percent level.

    Capital structures are specified for each year in the Range B30.R32. The data in B30.B32 are base year values, while planned departures from the base year data are specified in C30.R32. Since our principal concern is to analyze the effects of changes in capital structure, we normally change the capital structure ratios in various ways while holding the operating factors (inflation, demand growth, and so forth) constant. However, always keep in mind the fact that cost rates for new debt and preferred, and for all common equity, will change as the capital structure changes.

11. 1985 stock price. The 1985 stock price is a calculated value rather than an input value; the calculation is based on data in Section 3 (A95.R150) of the model. The calculations in Years 1 to 5 are based on a 5-year nonconstant growth model and on a constant growth DCF model thereafter. The 1985 stock price is calculated as the sum

of the present values of the 1986-1990 dividends plus the 1990 stock prices as determined from the constant growth model.

12. Payout rate. The base year payout rate is inputted into the model in B34 and then copied for the forecast period. The payout rate is used in Section 3 to determine total common dividends and hence dividends per share. One could change the payout on a year-by-year basis by unprotecting the model and making changes to Cells B34.R34. A review of investment advisory reports shows that a typical dividend payout rate for the electric utilities is around 70 percent; therefore, we used a 70 percent payout rate in this model.

13. Post 1990 dividend growth rate. This value is calculated in Cell G35 as follows: g = (1 - Payout rate) X (Earned return on equity). This calculation assumes constant growth. The growth rate is then used in the constant growth part of the stock price model discussed in Item 11.

14. 1985 book value. The 1985 book value is calculated in Cell B36 as the 1985 ending common equity divided by ending 1985 shares outstanding.

15. 1985 total assets, retained earnings, shares outstanding, total units (KWH or MCF) sold, and total unit (KWH or MCF) growth. These values are required inputs for the model (Cells B37.C41). Assets and retained earnings are used in Section 2 to develop the balance sheet, and the 1985 shares are used to calculate 1985 book value, which is used in Section 3 for the market/book ratio calculation. The 1985

shares also serve as a starting point to develop the per share analysis data in Section 3. The base year input data (all of which are in millions) for total assets (8,000), retained earnings (1,000), and shares outstanding (115) are all assumed values for a typical Florida utility. Once these values are entered, the forecast period values are determined by the model. Total assets in each year grow by the asset growth rate, while the amount of retained earnings depends on the utility's earnings (which is dependent on the current ROE and the amount of common equity) and the dividend payout rate. Shares outstanding at the end of the year depend on the number of shares repurchased or issued during the year, which is dependent on earnings, capital structure, and stock price.

Total units (KWH or MCF) sold are used to calculate the average unit price per 1,000 kilowatt hours which is obtained by dividing revenue requirements by total units sold and multiplying by 1,000. Total units (KWH or MCF) sold are assumed to grow at a rate of 2 percent, which is entered in Line 41 of the input section. The growth rate is assumed to be constant, so the base year growth value is entered and the model then copies the initial value into the other forecast years. (This can be easily changed.) In "shock cases," where, for example, load loss to cogeneration occurs, we could change the output growth rate. (See the Summary and Overview section of the report for a discussion of "shock cases.") Our initial output is 50,000 units; this value is arbitrary, but, in conjunction with our starting asset level and earned rate of return, it produces a cost per 1,000 KWHs that is "reasonable" for a Florida company.

16. Percentage breakdown of annual unit usage (C45.R48), annual unit usage (C54.R57), and percentage revenue breakdown by billing category (C63.R66). The percentage annual unit usage and percentage revenue breakdown values are entered manually into their input ranges; there are no formulas in either of these ranges, so the values can be easily changed for different assumptions. Note that each of these ranges contains a check item, Lines 50 and 68, to make sure the percentages entered total 100%. The annual unit usage values in C54.R59 are calculated on the basis of total unit quantity and percentage unit usage. These values are used in Section 3 of the model to develop both the breakdown of revenue by billing category and the price per 1,000 KWHs per billing category. The base year values used in the model are shown below:

Revenues:

	A	B	C	D	E
61					
62	Percentage Revenue Breakdown by Billing Category:				
63	Residential		40.00%		
64	Commercial		25.00%		
65	Industrial		30.00%		
66	Other		5.00%		
67			----------		
68	Total		100.00%		
69					
70					

Percentage unit breakdown:

	A	B	C	D	E
44	Percentage Breakdown of Annual Unit Usage by Billing Category:				
45	Residential		37.00%		
46	Commercial		25.00%		
47	Industrial		34.00%		
48	Other		4.00%		
49			----------		
50	Total		100.00%		
51					
52					
53					

Both dollars of revenue and units of output change over time, but the percentages are held constant in all our base case runs. However, in "shock case" runs, we would vary both the revenues and the unit mix across customer classes. (See the Summary and Overview section of the report for a discussion of "shock cases.")

17. <u>Dividends per share (C141.R141)</u>. Since we assume that all financing occurs at year end, dividends per share are calculated by dividing total common dividends paid by the number of shares of stock outstanding at the <u>beginning of the year</u>. The retained earnings for the year are used either to support asset growth or to repurchase common stock.

18. <u>Stock and bond issues/retirements</u>. Depending on its earnings, payout policy, asset growth, and capital structure, the company will have to issue or repurchase stock and sell or refund debt. Debt flotation costs are assumed to be amortized and thus are built into the cost rates assigned to debt, so they are included in the interest expense calculation. The equity flotation cost rate (which

can be varied) is entered in B21.R21 and is assumed to apply to both new issues and repurchases.

Common stock is assumed to be bought or sold at the end-of-year stock price. New common equity needed to maintain the target capital structure is met first from retained earnings and then from sale of stock. If the required amount of common equity declines, or if it increases by less than the retained earnings for the year, then common stock is repurchased. (Note: The company is assumed to receive the end-of-year price. The investment banker would deduct underwriting costs, but the company would, under the model's assumptions, immediately recover those costs through rates, because we assume that they would be expensed.)

Once all input values have been entered, one must press the F9 (CALC) key twice to solve the model. We used /WGRM and set the model for 15 iterations, and pressing the CALC key twice is sufficient to produce stable results. Sections 2 through 4 will automatically be generated in about 45 seconds on a PC AT; the running time is approximately two minutes on a PC or XT.

We should also sound a word of caution here. Due to interdependencies built into the model, one should not use the Range Erase command in combination with the F9 (CALC) key. Instead, it is necessary to replace existing data in Section 1 with your new data. Erasing the input data and then pressing the F9 (CALC) key will cause ERRs to appear throughout the model. Normally, that would cause no problems. However, when a model uses circular equations, an initial value for at least one of the variables involved is needed to get the iterative process started.

Pro Forma Financial Statements

Pro forma balance sheets and income statements for the 16-year forecast period are generated in Sections 2 and 3 (A74.R150) based on the input entered in Section 1 of the model.

Balance Sheets

The balance sheet, which begins in Cell A74, is calculated using inputs from Section 1. Total assets grow at the specified asset growth rate from the beginning base year value. Debt and preferred stock are calculated by multiplying the appropriate capital structure ratios by total assets. Except for the base year, the balance sheet item retained earnings is calculated as the previous retained earnings plus net income minus common dividends. (The base year value for retained earnings is taken from the input section.) Common stock is calculated by multiplying the common equity ratio by the total asset value and then subtracting retained earnings from this product. Line 92 in Section 2 is a check on the resulting calculations: If total claims do not equal total assets, there is an error in the model.

Income Statements

The income statements, which begin in A95, are developed on a bottom-up basis in the sense that net income is calculated first. Net income is calculated by multiplying the assumed earned return on equity by the previous year's ending common equity, which is the current year's beginning common equity. (Because the model assumes that all financing takes place at the end of the year, the current year's beginning common equity is outstanding throughout the entire year, until the new round of financing takes place at year end.) Once net income is determined, the remainder of the income statement is then calculated.

Except for the base year, preferred dividends are calculated as follows: (1) If preferred equity increases or remains the same, then preferred dividends are set equal to the previous year's dividends plus the increase in preferred equity, multiplied by the marginal cost of preferred, but (2) if preferred equity decreases, then preferred dividends are set equal to the previous year's dividends less the decrease in preferred, multiplied by the embedded preferred cost.

Equity flotation expenses are calculated by multiplying the number of shares either repurchased or issued by both the flotation cost percentage and the year-end stock price. Taxes are calculated by multiplying earnings before taxes by the tax rate; however, earnings before taxes (EBT) depend on taxes, because EBT is calculated as the sum of net income, preferred dividends, flotation expenses, and taxes. Thus, the model involves a set of simultaneous equations at this point (in 1-2-3 language, it is "circular"), so iterations are necessary.

Interest is calculated from the debt refunding schedule developed in Section 4. Section 4 layers the debt at each interest level, so interest is simply calculated by taking each debt layer, or vintage, multiplying it by the appropriate debt cost, and then summing these products. Earnings before interest and taxes (EBIT) is calculated by summing EBT and interest. The base year values of fixed and variable costs are taken from the input section, and these base year values are assumed to grow throughout the analysis period by the asset growth rate, which reflects both inflation and output levels. Revenue requirements are then determined by adding EBIT, variable costs, and fixed costs.

The revenue breakdown by customer class is calculated by multiplying total revenue requirements by the percentage revenue breakdown for each billing category. The price per 1,000 KWHs per billing category is then calculated by taking the appropriate revenue amount by billing category and dividing it by the annual unit usage for the billing category and multiplying by 1,000. Total units sold is obtained from the base year value, and the unit growth rate comes from the input section. Finally, the average price per 1,000 KWHs is calculated by dividing total revenue requirements by total units sold and multiplying by 1,000.

The remaining part of the income statement section shows a per share analysis and several ratio performance measures. The base year value for 1986 beginning shares is obtained from the model's input section, Cell B39. The number of shares issued or repurchased depends on several items: retained earnings, capital structure, and ending stock price. If common equity grows by more than the amount of earnings retained, common stock must be issued. The number of shares issued is calculated by the common equity increase less the earnings retained, all of which is divided by the ending stock price. Stock repurchases are obtained in a similar manner.

One further item should be mentioned. With the model on the computer screen, the word CIRC appears at the bottom of the screen. This term denotes circularity, or simultaneity, in the model as a result of the following: The number of shares either repurchased or issued depends on the ending stock price. However, the ending stock price is dependent on dividends per share, which depends on beginning shares, which in turn depends on the number of shares which were repurchased or issued the previous year. Therefore, we have gone full circle. Because of these interactions, the model has circular references, so it must be solved iteratively. We used the /WGR command, set at Manual with 15 iterations. Therefore, after data have been entered, the model will solve when the F9 (CALC) key is pressed.

Key Ratios and Performance Measures

The model calculates several key ratios and other measures of financial performance; they are shown in Range B139.R149, in Section 3. Key output values include the stock price at the end of each year, book value at the end of each year, the market/book ratio, EPS, DPS, the payout ratio, the return on beginning common equity (ROE), and the weighted average cost of capital. Most of these calculations are straightforward, but a few warrant explanation.

First, dividends per share (DPS, in C141.R141) for each year of the forecast period is calculated as total common dividends divided by beginning shares outstanding. Total dividends are equal to the payout ratio times net income. The payout rate comes from the input section, and the return on beginning equity serves as a check figure; it should equal the earned return on equity as entered in the input section. The calculation of the stock price deserves special mention. The model assumes nonconstant growth for the period 1986-1990 and constant growth thereafter. The stock price after 1990 is assumed to grow at the post-1990 growth rate as calculated in Cell G35 in the model's input section. The stock price for the nonconstant period is calculated as the sum of the present value of the dividends for the nonconstant period and the 1990 stock price as determined by the constant growth model. The stock price after 1990 (H144.R144) is obtained by multiplying the previous year's stock price by the post 1990 growth rate (G35).

Debt and Stock Transactions Schedule (A151.R175 and A134.R137)

We assume that all debt has a 30-year maturity, and that one-thirtieth of each vintage of outstanding debt matures and is refunded each year at the marginal interest rate specified for that year (B24.R24). The first part of Section 4 (A153.R164) shows the total amount of debt outstanding at the beginning of each year, and the second part of Section 4 (A165.R175) shows the net amount of debt refunded during each year. These values are then used in the interest calculation formula in the income statement, Section 3 (C124.R124). Stock transactions are determined in A134.R137, as was discussed earlier in this appendix.

Scenario Analysis

We run the model under several different scenarios, assuming different operating conditions, different capital structures, and different capital structure/capital cost relationships. We generally construct graphs to help analyze the results. It is easy to conduct scenario analyses and to use 1-2-3's windows feature to examine simultaneously the key output and the changed inputs. It is more difficult to get hard copy output because of the sheer size of the model. However, one can use the Range Value Copy command (available only in Version 2 of Lotus 1-2-3) to display selected key output results from each scenario in an empty section of the worksheet, then add another set of output to this section each time another scenario is completed, and finally print out the results of all the scenarios. Sections 5 through 8 of the model were constructed in just this manner. Notice that the amount of material in these sections varies depending on the number of scenarios one has analyzed. Note also that these sections do not change when data are changed and the F9 (CALC) key is pressed. To change these sections, one must go through the series of Range Value Copy commands (or a series of File Xtract and Combine commands for those using Lotus Version 1a). An alternative procedure would be to write a macro and then, when data changes occurred, one could invoke the macro to make the changes in Sections 5 through 8.

Summary

This appendix has described the Lotus 1-2-3 model we use to analyze the effects of capital structure changes on electric and gas companies. The model uses as inputs data on the relationship between capital structure and the cost rates on debt and common equity. Selected output from the model is presented in the Summary and Overview section of this report.

It is important to note that the model can be easily changed to reflect assumptions and input data different from the values we used. We believe that our assumptions represent a realistic view of the situation facing most electric and gas companies while still being streamlined enough to facilitate modelling. We also believe that our input data on the relationship between capital cost rates and capital structure are realistic and reasonable. However we recognize that others may wish to examine other inputs and assumptions in order to see how customers would be affected by such changes. We structured the model to make such changes as easy as possible, and we have tried to document the model in this appendix in a way that will facilitate making adjustments to the model.

APPENDIX G
DESCRIPTION OF THE PURC CAPITAL STRUCTURE MODEL:
TELECOMMUNICATIONS

This appendix describes a Lotus 1-2-3 model which analyzes the effects of a change in capital structure on a utility's stock price and financial position.[1] Inputs, including capital structure and component cost rates, are entered, after which the model forecasts the utility's balance sheets and income statements over a 16-year period. (The model includes a historic balance sheet for one year and pro forma balance sheets and income statements for 16 years.) The model also forecasts revenue requirements, market/book ratios, the weighted average cost of capital, customers' monthly bills, earnings and dividends per share, coverage ratios, and the estimated stock price for each forecasted year.

Required inputs include estimates of the cost of debt and equity under different capital structures. It should be recognized that no one can measure accurately the cost of equity at a given capital structure, much less tell precisely how equity costs will change if the capital structure is changed. In Appendices D and E we discuss our work on the relationship of the costs of equity and debt to capital structure. Still, judgments

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[1]Appendix G is very similar to Appendix F, except G deals with telephone companies while F is written for electric and gas companies. Someone interested primarily in telephone companies should skip F and read G, while people with a primary interest in energy companies should do the reverse.

must be made on these issues, and one advantage of the Lotus 1-2-3 capital structure model described in this appendix is that one can analyze the effects of different assumptions about the capital structure/cost rate relationship, with the output showing the sensitivity of customers' bills, coverage ratios, and so on to different assumptions. Therefore, the model can give decision makers insights into the effects of alternative courses of action under a variety of assumptions.

Because we wanted to examine different utility industries, we developed a model that with minor changes can be modified for electric, gas, or telecommunications companies. The modifications involve inserting terminology peculiar to each industry rather than major financial formula changes. For example, used with an electric company, the model would develop price per 1,000 kilowatt hours for each billing category: residential, industrial, commercial, and other. For a gas company, we would merely substitute MCF for KWH. However, for a telephone company the model would develop the monthly bill for residential customers and break it down into the basic bill and other charges. (The bill for other customers such as large business could be determined as well.) The telecommunications model is discussed in this appendix, the energy model in Appendix F. For ease of understanding, it is best to read this appendix sitting in front of a PC with the model on the screen.

Layout of the Telecommunications Model

The model is programmed in Lotus 1-2-3. Its layout is shown in Figure G-1, while Table G-1 shows the file's contents, provides instructions for use of the model, and gives the cell ranges of the various model sections.

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Table G-1
Contents of Telecommunications Model
and Directions for Its Use

I. The following sections are on this file:

Cell Range	Section Number	Description of Section
A1.R73	1	Assumptions and Inputs
A74.R94	2	Balance Sheets, 1985-2001
A95.R150	3	Income Statements, 1986-2001
A151.R179	4	Debt Refunding Schedule
A180.R194	5	Revenue Requirements under Various Model Runs
A195.R210	6	Output Prices under Various Model Runs
A211.R226	7	Costs of Capital under Various Model Runs
A227.R241	8	TIE Ratios under Various Model Runs

II. To position a section on the screen: Press function key F5, the "GoTo" key, then type the first cell shown in the range for the section, and then press the RETURN key.

III. The sections now have illustrative data. You can use the model with a specific company's data simply by entering new data in the highlighted cells in Section 1. When you enter data for a company, Sections 2 through 4 will be completed automatically. Note that all cells except the input data cells in Section 1 have been protected. The input cells which you may change are highlighted. If you need to modify the model formulas, you may disconnect the protect feature with this command: /WGPD. If you attempt to write in a protected cell, you will hear a beep and receive an error message. We recommend that you reprotect the worksheet after making your changes, using the command /WGPE. You should not use the Range Erase command to erase the input cells in Section 1. If you do, and if you then press the F9 (CALC) key, zeroes and ERRs will appear throughout the worksheet. Due to the circularity of the model, once error terms appear some of the formulas cannot be recalculated even after the new data have been entered--it is then necessary to edit the individual formulas. Therefore, you should simply replace the existing input values with your own data rather than by deleting our data and then changing blank cells.

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Figure G-1
Capital Structure Model Diagram, Telecommunications Model

MODEL SECTIONS	A1 A73	Section 1 Assumptions and Inputs	R1 R73
	A74 A94	Section 2 Balance Sheets	R74 R94
	A95 A150	Section 3 Income Statements	R95 R150
	A151 A179	Section 4 Debt Refunding Schedule	R151 R179
RESULT TABLES	A180 A194	Section 5 Revenue Requirement Results under Various Model Runs	R180 R194
	A195 A210	Section 6 Monthly Bill Results under Various Model Runs	R195 R210
	A211 A226	Section 7 Weighted Average COC Results under Various Model Runs	R211 R226
	A227 A241	Section 8 TIE Ratio Results under Various Model Runs	R227 R241

<u>Basic Assumptions and Input</u>

Certain basic assumptions are programmed into the model. You should be aware of them so that you will understand the model's limitations and also so that you can change our assumptions (by changing certain formulas) if you feel that they do not apply in the situation with which you are working. We combine our discussion of assumptions with a discussion of the input data section, Section 1. The cells in which data can be entered are unprotected and hence show up highlighted, while all other cells have been protected to prevent formulas from being accidentally changed or erased. The entries in Section 1 form the basis for the projected 16-year balance sheets and income statements. Please note that the model presents a base-year balance sheet and then forecasted balance sheets and income statements for 16 years.

1. <u>Model years</u>. We developed the model for a base year (1985) plus a 16-year forecast period (1986-2001). It would be easy to change either the base year or the forecast period.
2. <u>Inflation and tax rate</u>. Base year values for inflation and the tax rate are entered in B15.C16, and the model then copies them into the forecast years. However, if you wish to override the model and enter different values for different forecast years, this could easily be done by first unprotecting the model and then making the necessary changes. In our runs, we assumed a 5 percent inflation rate, and we used the current statutory tax rate of 46 percent. However, we also examined the impact of the

proposed tax law change to a 33 percent tax rate. (We discuss the effect of changes in the statutory rate in the Summary and Overview section of this report.) We do not deal explicitly with either the investment tax credit or depreciation rates.

3. Fixed and variable costs. The base year values for fixed and variable costs appear in Cells C17 and C18, while fixed and variable costs for the forecast period are in Section 3 of the model, in Range C120.R121. We have assumed that base year variable costs (1,000) are one-third the value of base year fixed costs (3,000), and we also assumed that both fixed and variable costs increase with the asset growth rate, which reflects both inflation and output growth. (All values are in millions of dollars.) It is implicitly assumed that construction costs increase by this same rate. Again, these assumptions could easily be changed by modifying the formulas in Range C120.R121.

4. Asset growth rate. We do not input separately an asset growth rate. Rather, we assume that all assets are used at the optimal operating rate. Therefore, the asset growth rate is a function of both inflation and output growth:

$$\text{Asset growth rate} = \text{Inflation} + \text{Unit growth} + \text{Unit growth} * (\text{Inflation})$$

5. Flotation cost. Many studies of equity flotation costs exist; generally, these studies indicate that such costs total from 3.5 to 4 percent of the gross proceeds. There have also been studies of market pressure, and of the best

way to handle the recovery of equity flotation costs plus pressure effects, but these issues are far more complex and controversial than flotation cost measurement.

We have assumed that flotation costs plus pressure total 2 percent. We input a base year value for the percentage flotation cost of an equity issue, and the model then copies the base year value into the forecast period. We assume that in the past equity flotation costs were not expensed, but that in the future they will be expensed as incurred, and hence they will be built into revenue requirements on an as-incurred basis. On the other hand, and consistent with accepted practices nationwide, we assume that debt and preferred stock flotation costs are amortized and are incorporated into embedded and marginal cost rates.

Equity flotation costs are calculated in Section 3 of the model in cells C128.R128 as follows:

$$\text{Equity flotation cost} = \text{Flotation cost percentage} \times \text{Number of shares repurchased or issued} \times \text{Year-end stock price}$$

Flotation expenses are not tax deductible, so they are subtracted from earnings after taxes have been calculated. The equity flotation cost percentage may be changed in each year by modifying the model in the input section, Section 1. Major model modifications would be required to change the assumption of equity flotation costs being expensed. (The treatment of these costs in practice presents, in our view, a major error in regulatory accounting. Oftentimes, these costs seem to be neither expensed nor capitalized, and the result seems to be nonrecovery unless a company is permitted to earn more than its bare bones cost of capital and to sell at a price above book value. At one point, we attempted to model this treatment of equity flotation costs, but the model became so complex that it obscured the capital structure issue, so we abandoned the effort.)

6. Debt, preferred, and common equity costs. The debt and preferred stock outstanding at the beginning of the analysis has an "embedded" cost. These base year data are entered in cells C25 and C28, respectively. The embedded cost of debt is the average interest cost on the currently outstanding debt. The embedded cost of debt after the base year is calculated as interest paid each year divided by total debt outstanding. The embedded cost of preferred equity is calculated as preferred dividends paid divided by total preferred outstanding. To simplify things, we assume that all financing is done at year end. Therefore, to calculate the embedded cost rates for the year, the beginning of year debt and preferred equity (which in this model are obtained from the prior year's ending balance sheet) are used in the calculation.

   New debt and preferred issues (marginal debt and preferred) normally have cost rates which differ from the embedded rates, and these marginal cost rates must be entered for individual years in Section 1 of the model in Ranges B24.R24 and B29.R29, respectively. Also, the cost of common equity capital must be entered in Section 1 of the model for each analysis year (B22.R22). Both the equity cost rate and the marginal costs of debt and preferred should, in general, be higher if more debt is used in the capital structure. However, as all finance textbooks indicate, and as all financial experts know, it is extremely difficult to specify the levels of these values. We discuss the basis for our inputs in Appendices C, D, and E.

One issue that arises is whether the marginal cost rates will jump to the new cost rates as soon as the new target capital structure is announced, or will change gradually, as the actual capital structure changes. We concluded that the cost rates would change abruptly if a weaker target capital structure were announced, even before the new target was achieved. Thus, if a company announced that it planned to increase its debt ratio from 50 to 60 percent, the cost rates on debt, preferred, and common would all rise immediately. We were less sure that the reverse would hold true--an announced plan to strengthen the capital structure might be greeted with skepticism, and investors might wait until the change had actually been made to lower the cost rates. Nevertheless, in our runs we assumed that capital costs would change immediately after any capital structure change announcement. In any event, the user is free to change our assumptions--the model permits any inputted marginal cost rates the user chooses to employ.

7. <u>Earned return on equity</u>. Under "perfect" regulation, the earned rate of return would exceed the cost of equity by 40 to 60 basis points to reflect an adjustment for flotation.

In the real world, allowed and earned rates normally vary from that ideal range. Still, in most of our runs, we specify that the company earns a rate of return that is 40 to 60 basis points above the cost of equity, and thus we assume "ideal" regulatory conditions. It is, however, easy enough to specify all manner of regulatory conditions; equity cost rates and the earned rate of return on equity are entered as separate inputs, so a model user can force the company to earn whatever rate of return he or she chooses.

The most interesting, difficult, and controversial issue is the relationship between the cost of equity and the capital structure. Our studies, which are described in Appendices D and E, suggest that a 2.5 percentage point change in the equity ratio, from its current level of about 57.5 percent, would cause a 20 basis point change in the cost of equity, and we used this specification in our most-likely case runs. However, we also changed the specifications to show what would happen if equity costs were either more or less sensitive to capital structure changes, and the model makes it easy for someone to input a wide range of inputs. Again, though, please note that we are prepared to defend our base case values, and others must be prepared to defend theirs.

The earned return on equity is entered in cells C23.R23 and then used in Section 3 of the model for calculating the company's net income in the range C131.R131. In the long run, assuming equity flotation costs are expensed and thus recovered on an as-incurred basis, utilities should have an earned return on equity which equals their cost of equity. In the short run, significant departures from the long-run ideal can occur. For example, if equity flotation costs have not been expensed, then the allowed (and earned) equity return should exceed the bare bones cost of equity. Further, if a utility (or its holding company) has unregulated subsidiaries, they can earn more or less than the cost of capital. Finally, a commission can use incentive rates under which companies deemed to be operating especially efficiently can be allowed to earn a return somewhat above their equity capital cost, while inefficient companies can be penalized.

All of these factors could have a bearing on the way the model is programmed, and on its output. For example, we could specify an equity capital cost and then force the earned equity return to equal that cost. An alternative specification--which we adopted in our model runs--is to specify both an equity cost rate and an earned return on equity, and then to have the model maintain these relationships. Note, though, that it would be a trivial task to force the two rates to be equal--one would merely need to specify one set of rates (say the cost of equity) and then copy those rates into the input range for the other variable.

8. <u>Embedded costs of debt and preferred</u>. Base year embedded costs of debt and preferred equity are entered in C25 and

C28 as previously discussed in Item 6. The starting points for the embedded costs of debt and preferred are 9 percent for debt and 8 percent for preferred. For years following the base year, the embedded debt and preferred cost rates depend jointly on the marginal debt and preferred costs and on the amount of debt and preferred raised each year. The embedded cost rates will normally be different from the costs of new debt or preferred issues. However, for our purposes we assumed that the embedded costs would equal marginal costs in the base year. Marginal debt and preferred costs are entered in Ranges B24.R24 and B29.R29, respectively. The base year values used for new debt and preferred--9 and 8 percent, respectively--approximate current new-issue rates. Marginal cost rates following the base year depend on capital structure changes. The relationship of debt costs to capital structure was developed from Standard and Poor's guidelines as discussed in Appendix E. We assumed that the marginal cost of preferred would change by the same amount as the cost of debt for a given capital structure change.

All debt is assumed to have a 30-year maturity, but this can be changed by modifying the formulas in Section 4 and in Cells C27.R27 of the input section. To change this assumption, one must change the number 30 wherever it appears in those areas and replace it with the alternative maturity value. A sinking fund provision built into the model requires that one-thirtieth of each debt vintage be retired in each year. Note that the percentage of debt retired in each year depends on both the maturity of the debt and the amount of debt at that maturity. The amount of debt refunded each year is calculated as the sum of each debt vintage divided by its maturity. The refunded debt is then reissued at the current (marginal) cost of debt for that year. The debt refunding and total debt outstanding schedules are shown in Section 4 (A151.R179). All financing is assumed to be done at the end of the year. The model forces the capital raised to be consistent with the prescribed target capital structure as given in Section 1 of the model, B30.R32.

The embedded debt cost, the embedded preferred cost, and the cost of common equity are used, along with the amounts of each type of capital, to calculate the weighted average cost of capital in C139.R139, in Section 3 of the model.

9. <u>Year currently outstanding debt redeemed</u>. This value, shown in Range C27.R27, is a calculated value based on the current year's value plus the average maturity assumed for the debt. If the average debt maturity assumption were changed, this formula would have to be modified. In this model we assumed that all debt has a 30-year maturity, and the debt has a sinking fund requirement which necessitates that one-thirtieth of each debt issue be retired each year.

10. <u>Capital structure ratios</u>. A review of typical telephone utilities' (Bell companies') capital structures indicates that an "average" structure consists of 42.5 percent debt, 0

percent preferred, and 57.5 percent equity, so these values were used for the base year. The values for the years that follow depend on whether we are examining a scenario where the target capital structure is changed to include more or less debt. For simplicity, the preferred ratio is assumed to remain at zero percent.

Capital structures are specified for each year in the Range B30.R32. The data in B30.B32 are base year values, while planned departures from the base year data are specified in C30.R32. Since our principal concern is to analyze the effects of changes in capital structure, we normally change the capital structure ratios in various ways while holding the operating factors (inflation, demand growth, and so forth) constant. However, always keep in mind the fact that cost rates for new debt and preferred, and for all common equity, will change as the capital structure changes.

11. 1985 stock price. The 1985 stock price is a calculated value rather than an input value; the calculation is based on data in Section 3 (A95.R150) of the model. The calculations in Years 1 to 5 are based on a 5-year nonconstant growth model and on a constant growth DCF model thereafter. The 1985 stock price is calculated as the sum of the present values of the 1986-1990 dividends plus the 1990 stock price as determined from the constant growth model.

12. Payout rate. The base year payout rate is inputted into the

model in B34 and then copied for the forecast period. The payout rate is used in Section 3 to determine total common dividends and hence dividends per share. One could change the payout on a year-by-year basis by unprotecting the model and making changes to Cells B34.R34. A review of investment advisory reports shows that a typical dividend payout rate for telephone companies is around 60 percent; therefore, we used a 60 percent payout rate in this model.

13. Post 1990 dividend growth rate. This value is calculated in Cell G35 as follows: g = (1 - Payout rate) X (Earned return on equity). This calculation assumed constant growth. The growth rate is then used in the constant growth part of the stock price model discussed in Item 11.

14. 1985 book value. The 1985 book value is calculated in Cell B36 as the 1985 ending common equity divided by ending 1985 shares outstanding.

15. 1985 total assets, retained earnings, shares outstanding, number of access lines, and access line growth. These values are required inputs for the model (Cells B37.C41). Assets and retained earnings are used in Section 2 to develop the balance sheet, and the 1985 shares are used to calculate 1985 book value, which is used in Section 3 for the market/book ratio calculation. The 1985 shares also serve as a starting point to develop the per share analysis data in Section 3. The base year input data (all of which are in millions) for total assets (13,000), retained earnings (1,000) and shares outstanding (78.68) are all assumed values for a typical telephone company. Once these

values are entered, the forecast period values are determined by the model. Total assets in each year grow by the asset growth rate, while the amount of retained earnings depends on the telco's earnings (which is dependent on the earned ROE and the amount of common equity) and the dividend payout rate. Shares outstanding at the end of the year depend on the number of shares repurchased or issued during the year, which is dependent on earnings, capital structure and stock price.

Total access lines are shown in Section 3 (C101.R101) and are assumed to grow at a rate of 1 percent, which is entered in Line 41 of the input section. The growth rate is assumed to be constant, so the base year growth value is entered and the model then copies the initial value into the other forecast years. (This can be easily changed.) In "shock cases," where, for example, loss to bypass occurs, we would change the output growth rate. (See the Summary and Overview section of the report for a discussion of "shock cases.") Our initial output is 8.8196 (in millions) access lines; this value is arbitrary, but in conjunction with our starting asset level and earned rate of return, it produces a monthly bill that is reasonable for a typical telephone company. Total access lines are used to arrive at the access line breakdown by billing category, which is calculated in Section 1 (C66.R68).

16. <u>Percentage revenue breakdown (C46.R50), percentage access line breakdown (C57.R59), and access line breakdown</u>

(C66.R68) by billing category. The percentage access line breakdown and percentage revenue breakdown values are entered manually into their input ranges; there are no formulas in either of these ranges, so the values can be easily changed for different assumptions. Note that each of these ranges contains a check item, Lines 61 and 52, to make sure the percentages entered total 100%. The access line breakdown values, by billing category, in C66.R68 are calculated on the basis of total access lines (C101.R101) and percentage access line breakdown by billing category. The percentage revenue breakdown by billing category is used in Section 3 to arrive at the actual revenue breakdown by billing category (C109.R113).

The base year values used in the model are shown below:

Revenues:

	A	B	C	D	E
44					
45	Percentage Revenue Breakdown by Billing Category:				
46	Large Business			11.55%	
47	Other Business			22.23%	
48	Residential Users			28.60%	
49	Long Distance Companies			26.40%	
50	Other			11.22%	
51				-------	
52	Total			100.00%	
53					

Output in number of access lines:

	A	B	C	D	E
56	Percentage Access Line Breakdown by Billing Category:				
57	Large Business			2.00%	
58	Other Business			29.07%	
59	Residential Users			68.93%	
60				-------	
61	Total			100.00%	
62					

Both dollars of revenue and number of access lines change over time, but the percentages are held constant in all our base case runs. However, in "shock case" runs, we would vary both the revenues and the access line mix across customer classes. (See the Summary and Overview section of the report for a discussion of "shock cases.")

The revenue for each billing category divided by the corresponding access line figure would determine the annual amount billed to large business, other business, and residential customers. In our model, we were primarily interested in residential customers; therefore, we have calculated the annual bill for residential customers in Cells C103.R106. It is important to note that because of the way this model is programmed, the billing amount includes basic service charges as well as other charges. We have assumed a 50-50 breakdown between the two. Any changes to this assumption would require a formula change to the model in Cells C104.R104.

17. <u>Dividends per share (C141.R141)</u>. Since we assume that all financing occurs at year end, dividends per share are calculated by dividing total common dividends paid by the number of shares of stock outstanding at the <u>beginning of the year</u>. The retained earnings for the year are used either to support asset growth or to repurchase common stock.

18. <u>Stock and bond issues/retirements</u>. Depending on its earnings, payout policy, asset growth, and capital

structure, the company will have to issue or repurchase stock and sell or refund debt. Debt flotation costs are assumed to be amortized and thus are built into the cost rates assigned to debt, so they are included in the interest expense calculation. The equity flotation cost rate (which can be varied) is entered in B21.R21 and is assumed to apply to both new issues and repurchases.

Common stock is assumed to be bought or sold at the end-of-year stock price. New common equity needed to maintain the target capital structure is met first from retained earnings and then from sale of stock. If the required amount of common equity declines, or if it increases by less than the retained earnings for the year, then common stock is repurchased. (Note: The company is assumed to receive the end-of-year price. The investment banker would deduct underwriting costs, but the company would, under the model's assumptions, immediately recover those costs through rates, because we assume that they would be expensed.)

Once all input values have been entered, one must press the F9 (CALC) key twice to solve the model. We used /WGRM and set the model for 15 iterations, and pressing the CALC key twice is sufficient to produce stable results. Sections 2 through 4 will automatically be generated in about 45 seconds on a PC AT; the running time is approximately two minutes on a PC or XT.

We should also sound a word of caution here. Due to interdependencies built into the model, one should not use the

Range Erase command in combination with the F9 (CALC) key. Instead, it is necessary to replace existing data in Section 1 with your new data. Erasing the input data and then pressing the F9 (CALC) key will cause ERRs to appear throughout the model. Normally, that would cause no problems. However, when a model uses circular equations, an initial value for at least one of the variables involved is needed to get the iterative process started.

Pro Forma Financial Statements

Pro forma balance sheets and income statements for the 16-year forecast period are generated in Sections 2 and 3 (A74.R150) based on the input entered in Section 1 of the model.

Balance Sheets

The balance sheet, which begins in Cell A74, is calculated using inputs from Section 1. Total assets grow at the specified asset growth rate from the beginning base year value. Debt and preferred stock are calculated by multiplying the appropriate capital structure ratios by total assets. Except for the base year, the balance sheet item retained earnings is calculated as the previous retained earnings plus net income minus common dividends. (The base year value for retained earnings is taken from the input section.) Common stock is calculated by multiplying the common equity ratio by the total asset value and then subtracting retained earnings from this product. Line 92 in Section 2 is a check on the resulting calculations: If total claims do not equal total assets, there is an error in the model.

Income Statements

The income statements, which begin in A95, are developed on a bottom-up basis in the sense that net income is calculated first. Net income is calculated by multiplying the assumed earned return on equity by the previous year's ending common equity, which is the current year's beginning common equity. (Because the model assumes that all financing takes place at the end of the year, the current year's beginning common equity is outstanding throughout the entire year, until the new round of financing takes place at year end.) Once net income is determined, the remainder of the income statement is then calculated.

Except for the base year, preferred dividends are calculated as follows: (1) If preferred equity increases or remains the same, then preferred dividends are set equal to the previous year's dividends plus the increase in preferred equity, multiplied by the marginal cost of preferred, but (2) if preferred equity decreases, then preferred dividends are set equal to the previous year's dividends less the decrease in preferred, multiplied by the embedded preferred cost.

Equity flotation expenses are calculated by multiplying the number of shares either repurchased or issued by both the flotation cost percentage and the year-end stock price. Taxes are calculated by multiplying earnings before taxes by the tax rate; however, earnings before taxes (EBT) depend on taxes, because EBT is calculated as the sum of net income, preferred dividends, flotation expenses, and taxes. Thus, the model involves a set of simultaneous equations at this point (in 1-2-3 language, it is "circular"), so iterations are necessary.

Interest is calculated from the debt refunding schedule developed in Section 4. Section 4 layers the debt at each interest level, so interest is simply calculated by taking each debt layer, or vintage, multiplying it by the appropriate debt cost, and then summing these products. Earnings before interest and taxes (EBIT) is calculated by summing EBT and interest. The base year values of fixed and variable costs are taken from the input section, and these base year values are assumed to grow throughout the analysis period by the asset growth rate, which reflects both inflation and output levels. Revenue requirements are then determined by adding EBIT, variable costs, and fixed costs.

The revenue breakdown by customer class is calculated by multiplying total revenue requirements by the percentage revenue breakdown for each billing category. The revenue breakdown for each billing category divided by the corresponding access line amount (C66.R68) would determine the annual amount billed to large business, other business, or residential customers. In our model, we were primarily interested in effects on residential customers; therefore, we have calculated the annual bill for residential customers (C103.R106). It is important to note that because of the way this model is programmed, the billing amount includes basic service charges as well as other charges. We have assumed a 50-50 breakdown between the two. Any changes in this assumption would require a formula change to the model in Cells C104.R104. Total number of access lines is obtained from the base year value, and the access line growth rate comes from the input section.

The remaining part of the income statement section shows a per share analysis and several ratio performance measures. The base year value for 1986 beginning shares is obtained from the model's input section, Cell B39. The number of shares issued or repurchased depends on several items: retained earnings, capital structure, and ending stock price. If common equity grows by more than the amount of earnings retained, common stock must be issued. The number of shares issued is calculated by the common equity increase less the earnings retained, all of which is divided by the ending stock price. Stock repurchases are obtained in a similar manner.

One further item should be mentioned. With the model on the computer screen, the word CIRC appears at the bottom of the screen. This term denotes circularity, or simultaneity, in the model as a result of the following: The number of shares either repurchased or issued depends on the ending stock price. However, the ending stock price is dependent on dividends per share, which depends on beginning shares, which in turn depends on the number of shares which were repurchased or issued the previous year. Therefore, we have gone full circle. Because of these interactions, the model has circular references, so it must be solved iteratively. We used the /WGR command, set at Manual with 15 iterations. Therefore, after data have been entered, the model will solve when the F9 (CALC) key is pressed.

Key Ratios and Performance Measures

The model calculates several key ratios and other measures of financial performance; they are shown in Range B139.R149, in Section 3. Key output values include the stock price at the end of each year, book value at the end of each year, the market/book ratio, EPS, DPS, the payout ratio, the return on beginning common equity (ROE), and the weighted average cost of capital. Most of these calculations are straightforward, but a few warrant explanation.

First, dividends per share (DPS, in C141.R141) for each year of the forecast period is calculated as total common dividends divided by beginning shares outstanding. Total dividends are equal to the payout ratio times net income. The payout rate comes from the input section, and the return on beginning equity serves as a check figure; it should equal the earned return on equity as entered in the input section. The calculation of the stock price deserves special mention. The model assumes nonconstant growth for the period 1986-1990 and constant growth thereafter. The stock price after 1990 is assumed to grow at the post-1990 growth rate as calculated in Cell G35 in the model's input section. The stock price for the nonconstant period is calculated as the sum of the present value of the dividends for the nonconstant period and the 1990 stock price as determined by the constant growth model. The stock price after 1990 (H144.R144) is obtained by multiplying the previous year's stock price by the post 1990 growth rate (G35).

Debt and Stock Transactions Schedule (A151.R175 and A134.R137)

We assume that all debt has a 30-year maturity, and that one-thirtieth of each vintage of outstanding debt matures and is refunded each year at the marginal interest rate specified for that year (B24.R24). The first part of Section 4 (A153.R164) shows the total amount of debt outstanding at the beginning of each year, and the second part of Section 4 (A165.R175) shows the net amount of debt refunded during each year. These values are then used in the interest calculation formula in the income statement, Section 3 (C124.R124). Stock transactions are determined in A134.R137, as was discussed earlier in this appendix.

Scenario Analysis

We run the model under several different scenarios, assuming different operating conditions, different capital structures, and different capital structure/capital cost relationships. We generally construct graphs to help analyze the results. It is easy to conduct scenario analyses and to use 1-2-3's windows feature to examine simultaneously the key output and the changed inputs. It is more difficult to get hard copy output because of the sheer size of the model. However, one can use the Range Value Copy command (available only in Version 2 of Lotus 1-2-3) to display selected key output results from each scenario in an empty section of the worksheet, then add another set of output to this section each time another scenario is completed, and finally print out the results of all the scenarios. Sections 5 through 8 of the model were constructed in just this manner. Notice that the amount of material in these sections varies depending on the number of scenarios one has analyzed. Note also that these sections do not change when data are changed and the F9 (CALC) key is pressed. To change these sections, one must go through the series of Range Value Copy commands (or a series of File Xtract and Combine commands for those using Lotus Version 1a). An alternative procedure would be to write a macro and then, when data changes occurred, invoke the macro to make the changes in Sections 5 through 8.

Summary

This appendix has described the Lotus 1-2-3 model we use to analyze the effects of capital structure changes on a telephone company. The model uses as inputs data on the relationship between capital structure and the cost rates on debt and common equity. Selected output from the model is presented in the Summary and Overview section of this report.

It is important to note that the model can be easily changed to reflect assumptions and input data different from the values we used. We believe that our assumptions represent a realistic view of the situation facing most telephone companies while still being streamlined enough to facilitate modelling. We also believe that our input data on the relationship between capital cost rates and capital structure are realistic and reasonable. However we recognize that others may wish to examine other inputs and assumptions in order to see how customers would be affected by such changes. We structured the model to make such changes as easy as possible, and we have tried to document the model in this appendix in a way that will facilitate making adjustments to the model.

APPENDIX H
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